

Railway Mechanical Engineer

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Practically all repair shops have as a basis of their operation some form of schedule system. One of the first things done in planning a schedule for locomotives or cars about to go through the shop is to examine the inspection reports on each unit to ascertain what class of repairs each locomotive or car is to receive. When this work is completed the schedule is then laid out and the cars are started through the repair shop. In other words, each locomotive or car to be repaired presents a problem which is solved by a process of collecting the facts, making a list of these facts and then deciding how and when the work is to be done. Why not do the same with your shop management problems that must be solved sooner or later? Making a list of these problems will not only serve as a reminder when your superior officer visits your shop and you wish to bring certain items involving expenditures to his attention, but will help to keep them in mind so that no suggestions bearing on their final solution will pass by unnoticed. Solving a problem of shop operation or organization before an exigency occurs is a big factor in obtaining efficient results, and will also eliminate the possibility of being placed in an embarrassing position by having to get along on a partial or unsatisfactory solution which has been worked out under the pressure of an emergency.

Make a list of your shop problems

One of the important objectives of a supervisors' or for men's club is to stimulate an interest on the part of its members in improving their leadership ability. Apparently with this thought in mind, all of the foremen's clubs on the Boston & Maine discussed the question of leadership at their October meetings. Certain members of each of the clubs were asked to prepare and read papers on leadership. All of the papers presented at all of the clubs were then assembled into a booklet, each foreman on the system being furnished with a copy of it. In the words of one of the men the idea "went over big."

Training for leadership

This is only one of a number of splendid things that are being done on the different railroad systems in the effort to develop a higher standard of leadership among the supervisors. Naturally it is resulting in a much more intimate contact between the representatives of the management and the workers, because it is being more and more recognized that no two individuals are alike and each one must be treated as an individual and in such a way as to inspire confidence and get him to utilize his particular talents to as great an extent as possible.

American industrial prosperity is said to be due in part to the fact that a larger use is being made of the intelligence of the workers and that they are not being hired for their manual skill alone. This intelligence, however, can only be released in the mutual interests of both the worker and employer by real leadership ability on the

part of the supervisors and officers. It means much for American railroads that the force of this truth is becoming more and more widely and generally recognized.

Commenting on the relatively greater success in many instances of railroad efforts to control locomotive smoke than of industrial efforts at minimizing smoke from power and heating plants, the Bureau of Mines, Department of Commerce, pays the following tribute to engine crews:

A tribute to engine crews

"Men who work on locomotives are usually more efficient than employees of small industrial plants and respond more readily to suggestions offered in smoke-abatement programs." The railroads have the advantage of more standardized mechanical conditions, on the whole, than ordinary stationary plants, but the crew is the most important single factor in minimizing smoke formation. It is pleasing to have from so impartial a source as the Bureau of Mines this public acknowledgment that engine crews average higher in efficiency and ready response to suggestions for smoke abatement than do stationary power plant operators. Usually the road foreman of engines is held responsible for the smoke performance of engines under the division master mechanic, the amount of smoke produced, in the last analysis, reflecting the ability of the individual engine crews. The Bureau points out in its bulletin that the engineman and fireman should be made equally responsible for results in order to gain the engineman's co-operation in working the locomotive. The advisability of equipping locomotives with blower valves on each side of the cab is suggested, as well as the use of present standardized smoke prevention equipment, such as multiple tip blowers, quick-opening blower valves, and induction tubes in the sides of the fire boxes when necessary to provide the air required for complete combustion. While the performance of engine crews in smoke prevention work may average better than that of stationary power plant operators, there is still need for improvement and further effort to educate and stimulate the interest of the crews in this subject which will doubtless return in direct saving far more than the cost of the educational work, to say nothing of the favorable public sentiment created.

In a large machine shop a drilling operation was performed on a radial drilling machine equipped with a single baseplate. A greater production was required and a similar machine was installed, but, on the advice of the machine tool builder, it was equipped with two baseplates.

The quality of machine tools

In operation the machine with the single baseplate was worked by one operator, and during the time the work was being set, the machine was idle. The machine with

two baseplates was worked by two operators, one of whom controlled the machine while the other set the work on the alternative baseplate, thus keeping the machine in constant operation. As the setting time was approximately equal to the drilling time, the output from the machine with two baseplates was double that of the other machine. The capital charge against each machine was equal, except for the cost of the extra baseplate. Obviously the parts were produced much more cheaply on the second machine than on the first.

That similar difficulties, although not of the same kind, affect the replacing of inferior machine tools with those designed for more economical operation, is indicated by the fact that almost every railroad shop has its share of machinery which has become obsolete from the standpoint of economic production. True, there are cases where the continued operation of very old machine tools may be fully justified; but this is the exception rather than the rule. The fact that obsolete machines are still found in railway shops may be attributed to several seasons, such as lack of capital, the lack of proper machine tool experts to present convincing arguments for modern machine tools to the management, and even to the indifference on the part of the master mechanic or shop superintendent toward the machine tool problem. Every machine tool in a railroad shop that has been in service ten years or more should be periodically compared with modern machines from the standpoint of the cost of operation and unit cost of production. Money available to the mechanical department for additions and betterments should then be placed where it will bring the greatest possible return.

There is much encouraging evidence of a growing appreciation of the value of beauty and harmony in the interior decorations of passenger equipment. So far, however, this has been confined very largely to Pullman cars and to special railroad-owned equipment which serves Pullman passengers. This, no doubt, is the result of competition between railroads which quite generally exists for the comparatively long distance traffic between the larger cities. Little attention so far has been given to the equipment which serves the passengers traveling between local points where competition between railroads does not exist. A new form of competition—that between all railroads on the one hand, and the privately owned automobile and the motor bus on the other—has been developing during the past few years. That this competition is effective is proved by the decline in passenger miles and passenger revenues during the past four or five years.

Are the railroads willing to allow the encroachments of these new competing agencies on their local passenger business to continue unchecked? Are not the same considerations which have led to the utilization of art in the interior decorations and furnishings of the through line passenger equipment just as applicable to the coaches which serve the local passengers? This question does not imply a belief that the same elaborate furnishings should be provided in coach equipment, but it does imply a belief that the local passenger is just as susceptible to the influence of pleasing surroundings, and certainly to anything which adds to his comfort, as is the long distance traveler. While a knowledge of the decorator's art is not a requirement of the mechanical department officer, it is within his power, co-operating with his passenger traffic officer, to initiate and guide the working out of a program of improvements in the

appearance as well as in the comfort of the railroad's coach equipment, which, if the experience of a number of electric railways is any guide, will mean increased patronage and increased revenue.

This applies to the old equipment as well as to that which is being purchased new. The rooms in homes are frequently redecorated. Is there any reason why the original type of interior finish of old passenger cars must be retained until the cars have been scrapped? The seats in automobiles have been made more comfortable than those in most coaches. Must the railroads continue to suffer this handicap until their present cars have been scrapped?

Many interesting facts relative to the careers of mechanical department officers in the railroad industry have been

A challenge to the mechanical department

brought out in the progress report of the Sub-Committee on Professional Service of the Railroad Division of the American Society of Mechanical Engineers, an abstract of which is published on another page of this issue. Undoubtedly the most startling fact is that only three railway presidents and five vice-presidents holding office today on 79 Class I railroads are products of the mechanical department. Compared with the number of executive officers taken from other departments, and especially the engineering department, this is a poor showing. But it is also brought out in the report that approximately 43 per cent of the executive and technical officers and the sales staffs of railway supply concerns have been recruited from the mechanical departments of the railroads. The report states that "the duties and responsibilities of many railway supply company executives involve problems of a mechanical engineering nature." This, undoubtedly, is one reason why more mechanical department officers become railway supply company executives than railroad executives.

The highly specialized work of the mechanical department officer, of course, makes it difficult for him to acquire an adequate picture of the work of other departments in order to fit himself for an executive position. Yet an executive must have an adequate appreciation of the work of all departments so that he can supervise their work effectively. This situation is a challenge to the mechanical department officer as well as to railroad management as a whole.

The *Railway Mechanical Engineer* has been active for many years in promoting a discussion as to the need of

Apprentice training progress

apprentice training and the ways and means of improving such training. Not only has it described in more or less detail the most successful methods which have been used, but it has sought to draw out in various ways frank expressions of opinion from the apprentices themselves as to the constructive value or lack of value of the practices under which they were being trained. Other agencies have also been at work attempting to promote a greater interest in this subject, with a view not only of training better workers but of developing the right sort of supervisors and officers for the future.

It is significant that the present season promises to mark the greatest advance which has ever been made in a similar period in the extension of apprentice training and the promotion of activities connected therewith. It is significant, also, that several of those who are promoting apprentice training have broken away from the beaten

paths and are trying some entirely new methods. There are various reasons for this. In some cases there has been a certain dissatisfaction with the older methods and a belief that better results might be obtained by their modification in various respects. Such modifications have been based upon studies of training methods in other industries or on experiences with the different methods used on various railroads. In other cases an attempt has been made to find a less expensive method of apprentice training as compared to the most advanced practices now in use.

It is significant, also, that while in the past the urge for better apprenticeship training has come largely from representatives of management, the workers in several instances in the past year or two have started the discussion and urged the necessity for improved training methods. In other words, the men are interested in improving the standards of their vocation and therefore adding to the dignity and prestige of their positions.

One of the great difficulties with present passenger car heating is due to non-uniform insulation, in accordance

Car heating and ventilation

with temperature and climatic conditions in the territory through which cars operate. Moreover, the window weather stripping; size, type and location of ventilators;

and education of train crews in the proper manipulation of deck sash or ventilators, all have an important bearing. The magnitude of fuel consumption for train heating purposes makes it imperative that present practices be checked with the greatest care to see what improvements can be made and what heat losses eliminated.

A passenger car is essentially a room on wheels with a large proportion of window area and exposure on all sides. Tests have shown that the modern steel car requires for heating about 2.85 lb. of steam per hour per degree of difference in external and internal temperatures. This difference may reach 75 deg. or more and in a 15-car train, therefore, about 3,200 lb. of steam per hour are required, or roughly, eight per cent of the boiler capacity of the average locomotive assigned to haul a train of that size.

Special emphasis has been placed recently on the lack of efficiency due to the use of 2-in. steam train lines which, however, are often restricted at the couplings to $1\frac{3}{8}$ in. openings. Tests now under way with unrestricted train lines and superheated steam are expected to show the possibility of greatly increased efficiency of the car heating plant, enabling long trains to be heated adequately under the most severe weather conditions.

Adequate passenger car ventilation also presents a serious problem in which the operation of ventilators is of prime importance in securing a happy medium between too little ventilation when the car is standing and too much when moving at highest speed. One of the most comprehensive recent surveys of passenger car heating and ventilation requirements was that by K. F. Nystrom, engineer of motive power and rolling stock of the Chicago, Milwaukee & St. Paul, published beginning on page 155 of the March, 1924, *Railway Mechanical Engineer*, and page 227 of the April issue of the same year. Mr. Nystrom emphasized the need of keeping deck screens and ventilators clean, educating trainmen in the proper use of deck sash and installing exhaust fans wherever necessary to supplement natural exhaust ventilators. It is said that probably no other feature having to do with the comfort of steam train passengers has been the source of more complaint on

the part of fastidious passengers and even those of average sensibilities than has the matter of ventilation of passenger coaches and sleeping cars.

New Books

TRAVELING ENGINEERS' ASSOCIATION PROCEEDINGS. Edited by W. O. Thompson, secretary, Cleveland, Ohio. 171 pages, 5½ in. by 8½ in. Bound in cloth. Price \$1.50 per single copy.

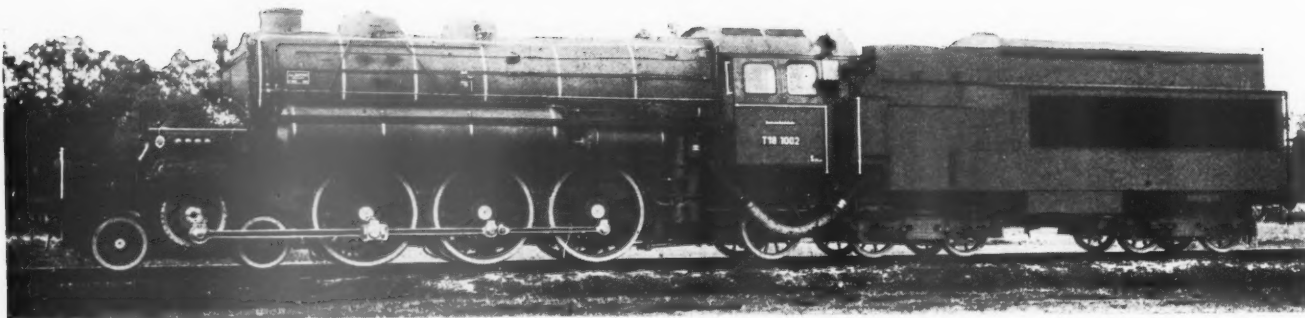
A wealth of material of interest to traveling engineers, road foremen of engines and others, is contained in this report of the thirty-fourth annual convention of the Traveling Engineers' Association, held at Chicago, September 14, 15, 16 and 17, 1926. The contents of the book are arranged the same as that in preceding convention reports, one of the interesting features in each annual volume being a brief report of the subjects considered at each convention since the first held at Chicago in 1893.

FUNDAMENTALS OF THE LOCOMOTIVE MACHINE SHOP. By Frank M. A'Hearn, assistant general foreman, Bessemer & Lake Erie, Greenville, Pa. Bound in cloth, 4½ in. by 7½ in. 242 pages, illustrated. Published by the Simmons-Boardman Publishing Company, 30 Church street, New York. Price \$2.50.

This volume, dedicated to the ever ingenious and resourceful railroad shop machinist, contains a wealth of information which any man engaged in that vocation can use and appreciate. Study of the contents shows that the book is well named. The author has evidently taken particular pains to stick to fundamental practices that have proved to be good locomotive shop practices in past years, are good today, and will be good tomorrow. The machinist is not, however, the only locomotive shop worker for whom the author has written this book. He has outlined for the more advanced workmen, the supervisors and for those interested but not directly engaged in machine shop work, a summary of the methods and tools used in railroad shops.

Single chapters are devoted to distinctive types of machine tools, such as the engine lathe, planer, drill press, boring mill, grinding machine, etc., in order to meet the needs of the machine shop foreman, the machinist, the special and regular apprentice, and the mechanical engineer whose work requires a close acquaintance with shop operation and practices. The first two chapters are on the subjects of shop location and arrangement, and setting machine tools. The third chapter is devoted entirely to belting and chapter four, to shop operation. The remaining 16 chapters are on the various types of machine tools used in a locomotive machine shop. In addition to the 20 chapters on different phases of locomotive shop work, the book contains an appendix of useful rules and tables, many of which the author has taken from his note book and which he found to be helpful to him in the day's work around the shop.

Mr. A'Hearn has been a contributor to both the railway and machine shop trade publications for a number of years. Many are familiar with his "John Dick" stories which have been published from time to time in the American Machinist and have also read articles he has contributed to the *Railway Mechanical Engineer* and *Railway Review*. This is his first attempt at writing a book. Long experience in locomotive shop work has, however, well qualified him to write on the subject he has selected.—M. B. R.



Turbine locomotive built for the German State Railways by I. A. Maffei, Munich, Bavaria, Germany

Turbine locomotive for the German State Railways

Designed for experimental heavy express service—
Develops 2,500 hp.—Total weight 229,000 lb.

*By G. J. Melms
Consulting engineer, Paris, France*

THE endeavor to develop the steam locomotive to a high state of efficiency has resulted in the German State Railways placing an order for a second turbine locomotive from I. A. Maffei, Munich, Bavaria, Germany. This locomotive, which was recently delivered, develops 2,500 hp., and is designed to haul heavy express trains at an average speed of 62 m.p.h. and at a maximum speed of 78 m.p.h. The general design and construction of this locomotive has been made as far as possible similar to that of the standard reciprocating Pacific type locomotives recently adopted by the German State Railways. The diameter of the driving wheels of the turbine express locomotive is 68.8 in., which is about 10 in. less than that of the standard locomotives.

Following the same general trend in the design of the standard locomotives, the construction of all parts of the new turbine locomotive is of the greatest simplicity and they are easy of access. The total weight of this locomotive is 229,000 lb., of which 132,000 lb. is carried on the drivers. The boiler is of conical construction and operates at a pressure of 324 lb.

It was left to the builders and principally to the chief engineers, C. Imfeld and Mr. Ludwig, to comply with the required operating conditions and the following description may serve to show the reader how far the problem has been solved.

The turbine and the electric locomotive naturally have many features in common, one of the most important being a smooth starting tractive force. Having a higher adhesion, a greater proportionate tractive force can be utilized than is possible with a reciprocating type locomotive and besides the reciprocating and other parts can be dispensed with.

The greater axle loads permit an increase in the total weight of the locomotive, which made it possible for the builders to increase the boiler pressure to 324 lb. Because of the high pressure and the saving of steam by the condenser, the dimensions of the normal locomotive boiler were considerably reduced. Shortening the boiler

length and reducing the smoke box dimensions created additional space on the front end of the locomotive, making room for the turbine and the reduction gearing.

Similar to the electric locomotive, the turbine gear drive is so arranged that the power of the turbine shaft is transmitted by two pinions through reduction gearing to a jack shaft and from this shaft to the main connecting rods and the six-coupled driving wheels.

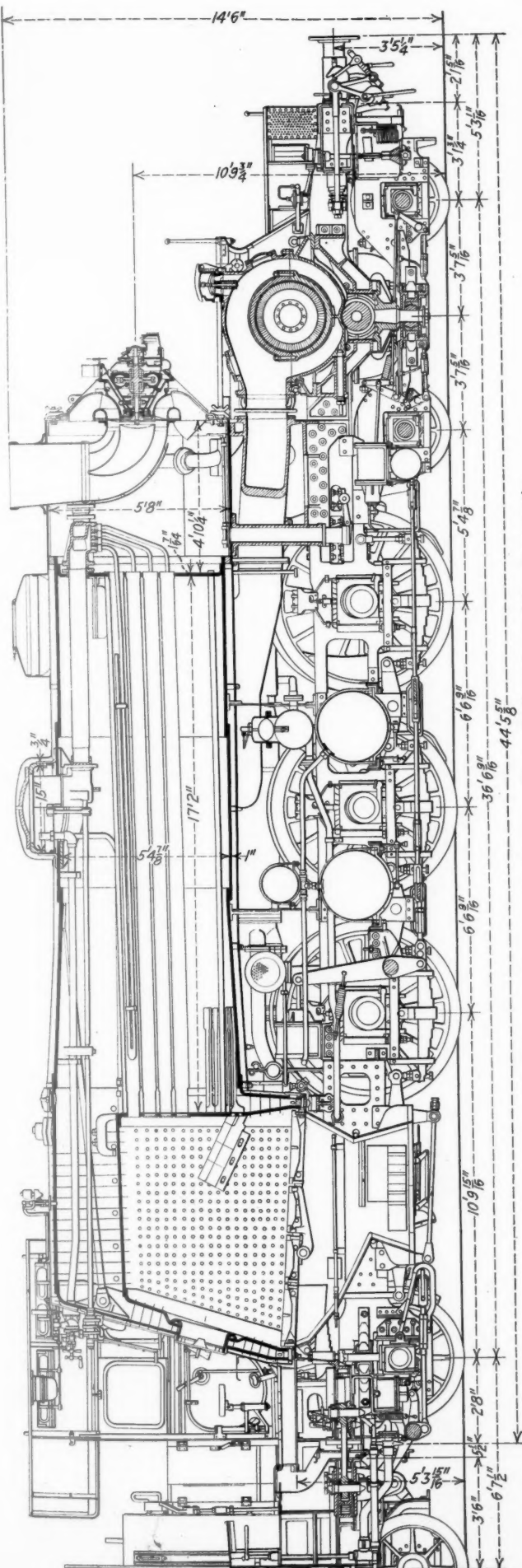
General description of the Maffei locomotive

Two surface condensers are located on each side of the boiler. The exhaust piping to these condensers pass through the center supporting yoke of the boiler. A suction draft fan, directly connected to a small turbine, is fixed to the inner side of the smoke box door, and serves to eject the waste gases. The air of the condenser is removed by two single-stage air suction steam ejectors. The condensate water is removed by a pump directly connected to a piston feedwater pump. A Westinghouse air compressor and small turbine-driven dynamo for electric lighting, etc., are also provided.

The tender has been considerably increased over the standard length, the forward part having storage space for fuel and feedwater. Adjoining this is a small space for the turbine which drives the air fans and the cooling water pump. The remaining portion is occupied by the cooling installation, which consists essentially of a spray cooler. The water flows downward over flat metal sheets while the cool air is admitted through the sides of the tender and passes over the flat metal surfaces exposed to the spray, finally being ejected by two fans placed horizontally in the roof of the tender.

Comparative weights of the turbine and standard Pacific type locomotives of the German State Railways

	Turbine locomotive	Standard Pacific type locomotive
Weights in working order:		
On drivers.....	132,000 lb.	132,800 lb.
Total engine.....	229,000 lb.	249,000 lb.
Total tender.....	150,000 lb.	148,000 lb.
Total engine and tender.....	379,000 lb.	397,000 lb.

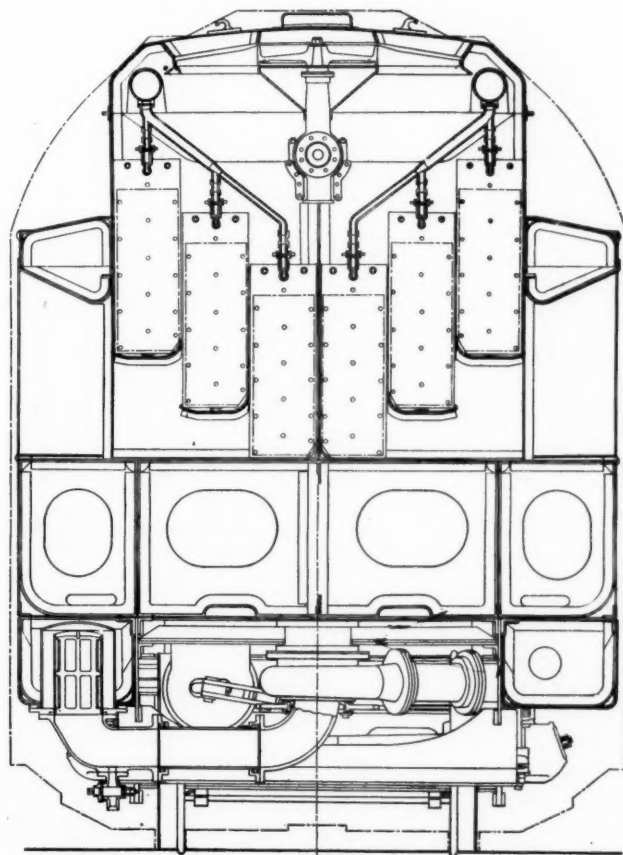


Elevation drawing of the German State Railway's turbine locomotive

The turbine locomotive, considered alone according to the figures comparing it with the standard Pacific type, is the lighter of the two, so the weight of the condensing apparatus results in less weight than that of a standard locomotive.

It is evident that the cost price of the turbine locomotive will be higher than the reciprocating locomotive, but the latter has the advantage of a century of experience in production which can only be overcome as turbine locomotives increase in number. Of the coal consumed, 15.6 per cent of the total heat can be utilized at the crank pins when the locomotive runs at the rate of 43.5 m.ph., whereas the express reciprocating type locomotive of standard construction will give a value of seven to eight per cent.

It has been estimated that one horsepower at the jack shaft will absorb 7,280 B.t.u., or with coal having 12,-



End elevation of the tender, showing the water cooling units

780 B.t.u., 1.26 lb. of coal per horsepower (including the steam used for the auxiliary machinery). In the winter, the total net efficiency will be increased, due to the train heating, and it is then expected to increase up to 20 or 22 per cent.

The feedwater of the turbine locomotive is forced through two feedwater heaters placed in series, and is heated by the exhaust steam from the auxiliary machines up to a temperature of about 260 deg. F. It must be admitted that by pre-heating the air for combustion, or by increasing the feedwater heating installation, further saving can be obtained. For example, an increase in the feedwater temperature up to 570 deg. F. and above, by means of the exhaust gases, would also require an increase of the heating surface of the feedwater heater. Cooling the exhaust gases would diminish the volume of the gases and permit the installation of a smaller exhaust fan, which would reduce the amount of

work at this point. A saving of 4 per cent could thus be obtained, but at the cost of considerable complications.

The main turbine and reduction gear

The turbine is situated above the engine truck with its axis at right angles with the center line of the locomotive and transmits its power by means of a double reduction gear through connecting rods to the driving wheels. The forward drive and the backward drive turbines, are enclosed in the same housing. At a locomotive speed of 78 m.p.h. the turbine shaft runs at 8,800 r.p.m., which is reduced through a gear ratio of 1 to 24.

The forward turbine consists of two discs in the high pressure end, each containing one row of blades at the rim, followed by an impulse wheel and five reaction wheels of suitable diameters. The end thrust is counter-balanced by a balance piston at the high pressure end.

The backward drive turbine consists of a velocity disc of smaller diameter having three rows of blades revolving in a vacuum while the forward drive turbine is in action. The steam expands in the nozzles of the backward drive turbine from admission to vacuum and exerts but little reaction effect on the blading. The housing of the backward drive turbine is located inside of the main turbine and its construction provides a guide channel so arranged that the exhaust from both turbines is led to the same outlet without interfering; that is, it prevents the steam from one from entering the blading of the other. It is evident that the backward drive turbine cannot produce the same effect as the forward, but this is a secondary question for an express locomotive.

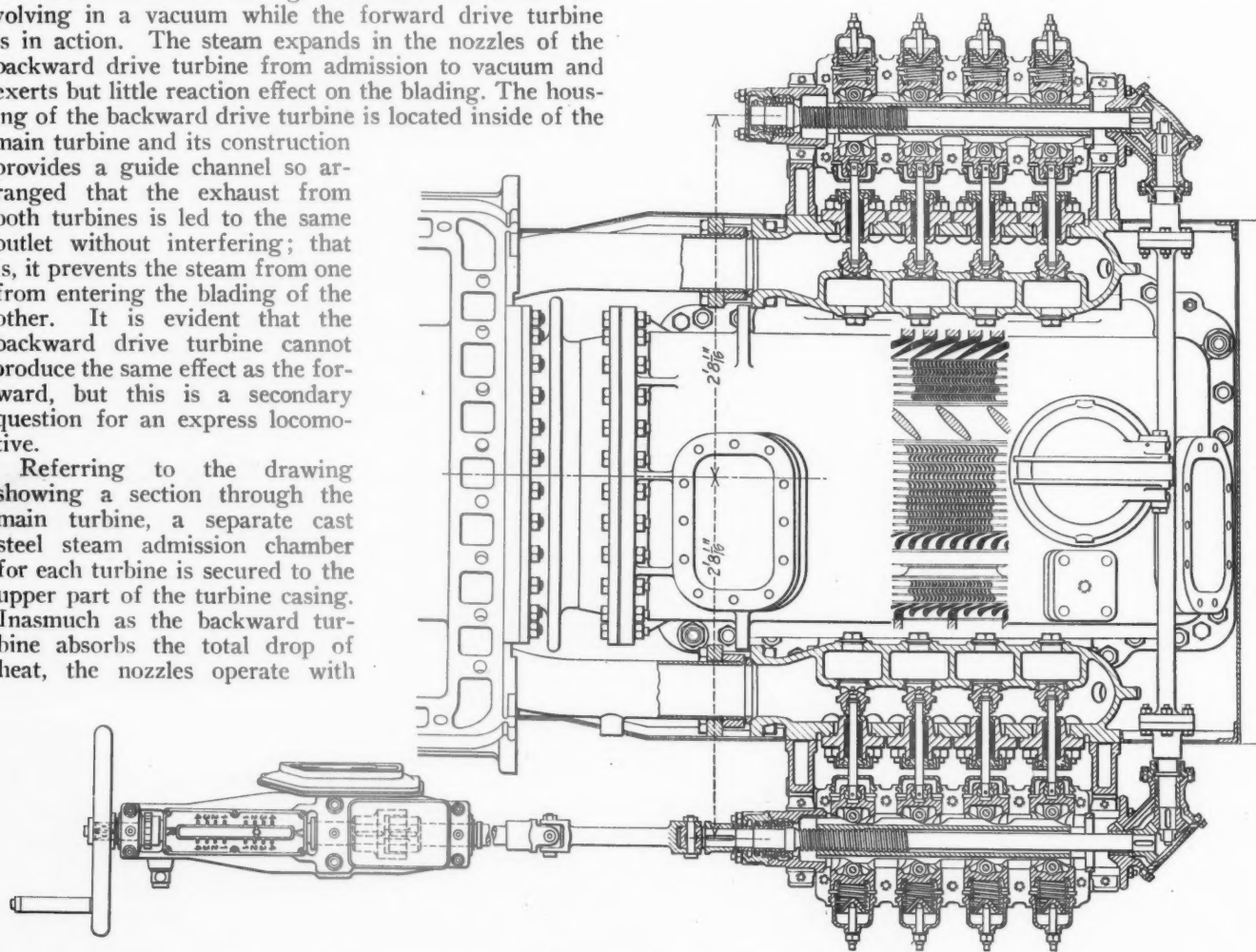
Referring to the drawing showing a section through the main turbine, a separate cast steel steam admission chamber for each turbine is secured to the upper part of the turbine casing. Inasmuch as the backward turbine absorbs the total drop of heat, the nozzles operate with

in order to permit the steam to flow to both of the surface condensers located on both sides of the boiler, as shown in the cross-section drawing, through the smoke-box.

In case the condensers should fail to function, a safety valve prevents any undue pressure on the turbine vacuum pipe line and in the condensers. The safety valve will come into action if the cooling apparatus fails to operate, whereas in case of an accident to the condensate pump, the steam will continue to be condensed and the condensate in by-passing the condensate pump, will then be forced into the feedwater reservoir on account of the high pressure. In this case, the steam injectors can be placed in service.

Construction of the main turbine blades

The turbine blades are milled out of the solid nickel steel and are machined in special jigs to insure absolute



Drawing showing the blade arrangement of the main turbine and method of controlling steam distribution

total admission. For that reason the steam admission passages in the casing leading to the nozzles have been made larger than the customary design.

The ends of the shafts of the turbine spindle, referring to the section drawing of the main turbine, are provided with dummy packing which permits the necessary end play. The exhaust flange located on the upper half of the turbine casing, shown in the drawing of the blade arrangement, is coupled to a flexible expansion joint which, in turn, is attached to the boiler support. This support is so arranged as to serve as a continuation of the vacuum pipe and is divided into two branch pipes under the boiler

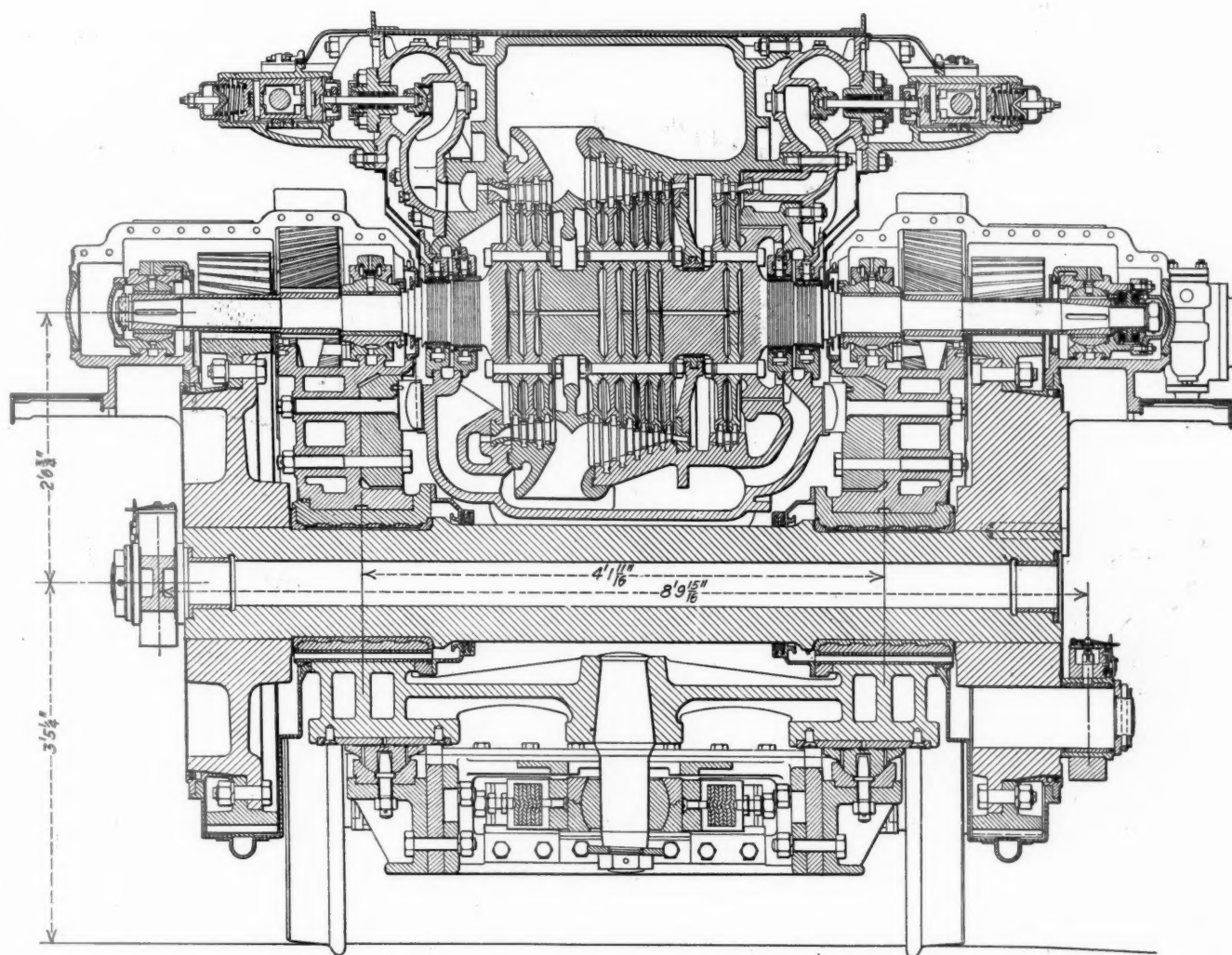
accuracy. The shape of the socket of the blades is made somewhat in the shape of a distorted parallelogram, so that the blades can be inserted in the rim of the disc by a turning motion of the blade. This design eliminates the need of enlarging the groove in the disc and also provides a secure attachment of the blades to the rim. Notches on both sides of the blade fit into a suitable projection in the groove of the disc. Blades having the greatest lengths have tapered tips to compensate for the increased stress. The material from which the blades are milled varies from 3 to 5 per cent nickel steel or chrome-nickel steel, according to the stress the various blades are

subjected to. The shroud ring is made of Monel metal.

In order to insure good efficiency even at low load, the forward as well as the backward drive turbines are regulated by four single nozzles. The two cast steel admission chambers attached to the two sides of the upper half of the casing have an independent pipe connection to the superheated steam chest. The valves, provided with nickel seats, are self-closing with positive openings and are connected together by means of a regulator shaft and bevel gears. They can be directly manipulated by the reverse gear control in the cab. A dial and pointer indicate the position of the various valves. The gear can be conveniently handled in a manner similar to that used on most steam locomotives in Europe.

The pinions are located in an exact line with the two intermediate gears. The former are subject only to torque stresses. The shafts are not subjected to any bending moment. The two intermediate gears transmit the total force.

It was found to be expedient to provide a certain flexibility in the direction of rotation which would also tend to insure that each gear would take its share of the work. Springs permit the gear frame to be subjected to considerable play in both directions of rotation. Inasmuch as two pinions act on each intermediate gear, the width of the teeth could be somewhat reduced, but it is evident that, in order to insure faultless operation, the various bore holes for the spindle intermediate shaft and



Horizontal section through the main turbine

The main regulating valve is not balanced, and it can only be opened by means of a small auxiliary valve. The opening of the auxiliary valve causes a rise in pressure behind the seat of the main valve, all the nozzle valves being closed at the same time. With this arrangement the engineman is obliged to use the gear control for pressure reduction, and not the regulating valves.

The turbine shaft is rigidly secured in the bearings and, in addition, the projecting ends are suitably guided. The pinions are secured to the shaft ends on conical stubs, as shown in one of the drawings, and are allowed little play in the direction of rotation. This is because the ends of the turbine shaft, as well as the hollow shaft on which the pinions are mounted, are of flexible con-

struction. The pinions are located in an exact line with the two intermediate gears. The former are subject only to torque stresses. The shafts are not subjected to any bending moment. The two intermediate gears transmit the total force.

A gear-driven oil pump which operates in both directions is connected to one of the turbine shafts. It pumps lubricating oil from the reservoir and forces it directly into the pipe which distributes the oil to the various bearings. The usual modern devices used to lubricate high-speed pinions with spray and oil vapor, as well as an oil-cooling apparatus, are provided. The cooling effect of the air, when the locomotive is in motion, is uti-

lized and provision is also made to cool the tubes of the oil-cooling apparatus with water, which is controlled by the engineman.

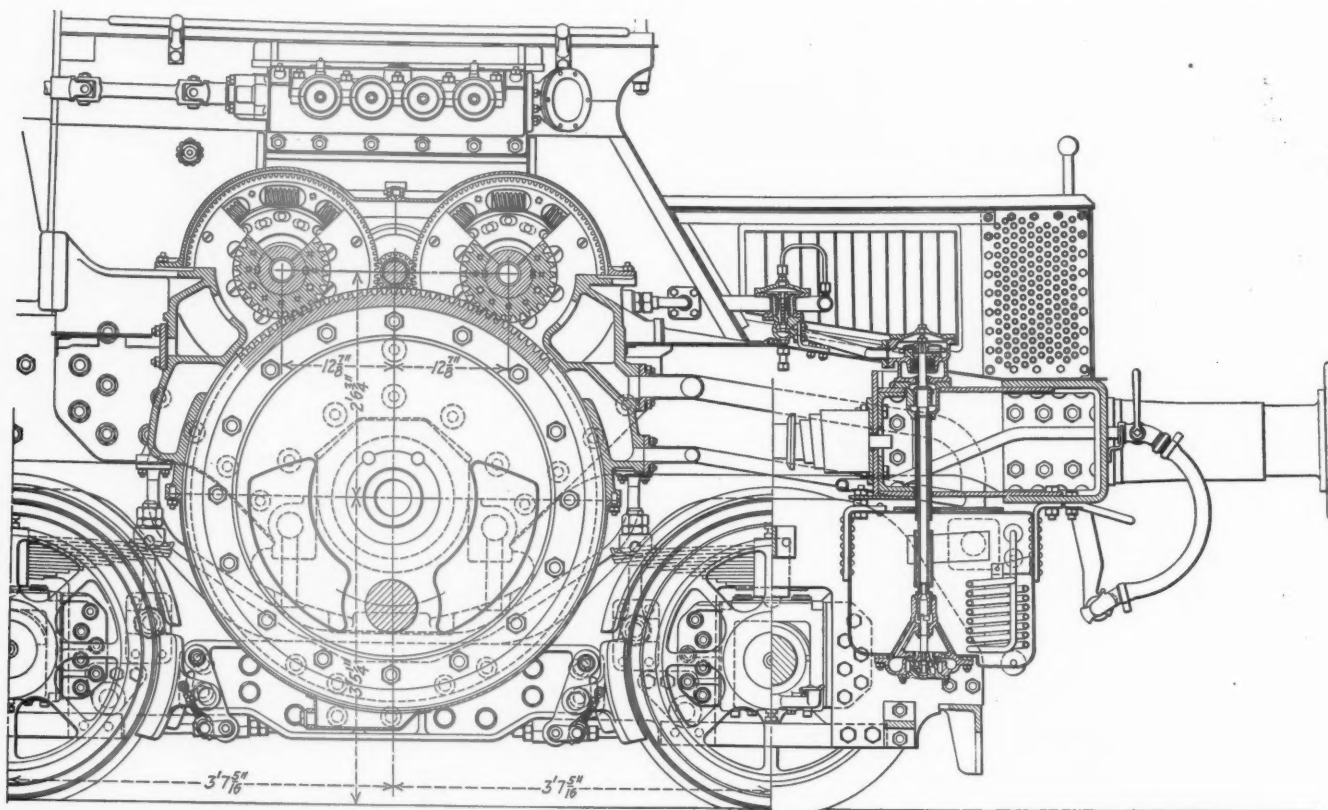
The condensers

The two condensers are connected in parallel for both the flow of steam and of water. The cooling water flows in four streams, so that a high rate of flow is obtained. A separate group of cooling tubes for the trapped air is provided. Suitable care in the construction of the joints and the mode of adjustment of the tubes to prevent sagging has been taken and the tubes can be inspected or removed without having to remove the condenser from the locomotive.

The condensate flows from the condensers to an intermediate tank provided with a float gage. From here it is drawn off by the condensate pump which is directly connected to the feedwater pump. These pumps are sur-

The feedwater heater tanks are located in the rear of the condenser. The steam in one is under atmospheric pressure. This heater absorbs the exhaust steam from the feedwater pump, the air compressor, the two steam ejectors and the dynamo turbine, which heats the water coming from the condensers at from 110 to 120 deg. up to 190 deg. or 200 deg. F. The water is then forced to the second feedwater heater to which steam is admitted at about 37 lb. gage pressure. This heater receives the exhaust from the turbine connected to the cooling water pump on the tender and part of the time it also receives the exhaust steam from the suction draft turbine, which reheats the water up to a temperature of about 260 deg. F. Any superfluous steam passes through a regulating valve to a low pressure stage of the main turbine.

In order to save steam under all conditions, a small additional condenser is placed between the main conden-



Arrangement of reduction gearing from the main turbine

rounded by a water chamber connected to the feedwater reservoir in the tender. The condensate pump can only work up to atmospheric pressure; the feedwater pump forces water out of the reservoir into the boiler.

The feedwater heater

A by-pass in the feedwater pipe enables the engineman to allow the feedwater pump to run without load for a time, in order to enable the condensate pump to work independently. The speed of the pump can be controlled from the cab. In case the speed of the pump is not sufficient, the water in the intermediate tank is raised and the float gage indicates this in the cab. This warns the engineman to operate the pump at a greater speed. But, as the capacity of the condenser pump is about 20 per cent greater than the feedwater pump, this indication will not often occur. The air in the condensers is ejected by two steam ejectors, the exhaust steam from which is condensed in the feedwater heater.

ers, in which the non-condensed steam from the feedwater heater is condensed and the water flows back to the reservoir.

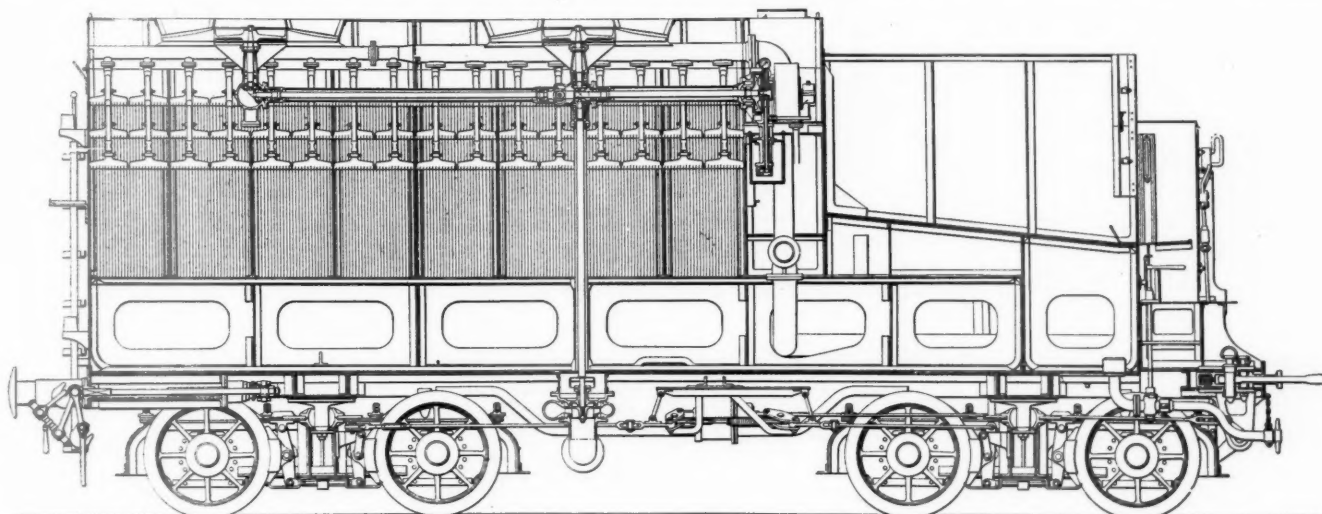
Two detachable rubber hose equipped with self-adjusting couplings, conduct the cooling water to and from the tanks of the tender. Live steam flows from the engine to the tender through a combination metal hose, located near the center line of the locomotive.

New design of suction draft is provided

A novel construction was created in order to solve the important question of suitable draft in the smoke box. As may be seen from the drawings, a small high speed turbine is located in the door of the smoke box, which operates with superheated as well as with saturated steam. It is directly coupled to a draft fan of special design. This fan is extremely simple in design and form, made of non-rusting Bohlsteel, and ejects the gases from the smoke box.

The draft fan operates at a speed of from 6 to 7,000 r.p.m. This unit and its housing form the projecting point of the door which receives a strong cooling effect on the front bearing and the oil chambers directly adjacent, while the locomotive is running. The turbine casing has ribs cast on the outside to cause the air to circulate around the turbine and also to cool the bearings.

The tender has an overall length of 37 ft. 8 $\frac{3}{4}$ in. and is mounted on two four-wheel trucks. A water tank having a capacity of 1,138 gal. is located in the forward end and directly above it is the coal bunker having a capacity of 6 tons. A partition is inserted between the coal bunkers and the cooling compartment for the turbine driving the feedwater pump and the fans



The tender, showing the location of the condenser and auxiliary equipment

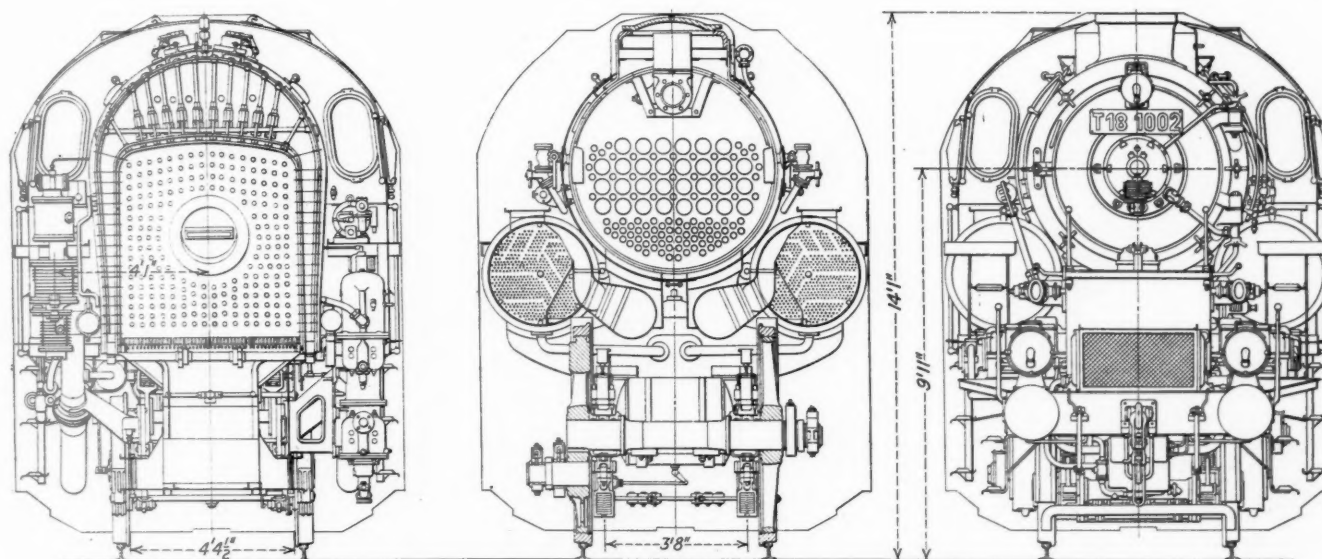
The admission valve of the turbine is controlled directly by the engineman in the cab. The exhaust steam from the turbine flows into the second feedwater heater, and is controlled by a valve that admits the steam at a pressure of about 37 lb. per sq. in. gage. In case this heater is fully charged, the steam is turned into a low pressure stage of the main locomotive turbine.

This draft system was thoroughly tested and it was

for the cooling compartment, to which access is provided from the top.

The tender

The turbine is geared to a main horizontal shaft from which the power is transmitted by means of bevel gears, to the vertical shafts of the fans and the cooling water pump. It operates at 6,000 r.p.m., whereas the cooling



Cross sections through the firebox, smokebox and elevation drawing of the front end

found that the desired pressures could be obtained with high efficiencies. It has the advantage of high speed which enables it to be coupled up directly to a high speed turbine. The speed need only be adjusted by the throttling valve and it will remain constant, regardless of variations of the gases or other conditions. No extra regulating devices such as a safety cutout, etc., are necessary.

water pump and the two fans have a speed of 1,000 r.p.m. The fans require 13 hp. and exhaust 882.5 cu. ft. per sec. The pump absorbs 23 hp. and delivers 12,380 cu. ft. per hour.

The rear and greater part of the tender is occupied by the cooling installation, but the space thus used is only about one tenth of that usually required for stationary installations. Extraordinary conditions being present

made it imperative to find new methods and apply new principles. It was found by actual experiment to be very important to prevent drop formation, as a drop of water is carried away by the current of cooling air. The cooling air must follow a line of least resistance in order to save power for ventilation; vibration must be eliminated and all parts must be so located as to be easy of access. It is not possible to cool by means of a blast of air on account of the great amount of space required.

It must be considered that from about 16 million to almost 18 million B.t.u. per hour will have to be taken care of, a figure which is too great for air ventilation only. Air is admitted on both sides of the tender, passing through air deflectors and is ejected by means of two horizontal ventilators placed in the roof. The compartment for recooling is subdivided into various cooling elements. These elements, of which there are 48, consist of closely packed perforated sheet copper which are separated by pass pieces and held together by bolts. The air passes between the copper plates in an opposite direction from the downward flowing cooling water, which flows in sheets, thus avoiding drop formation.

The experiments proved that this construction insures the greatest economy of water and that the loss of water was not any greater than the evaporation determined by calculation. It is evident that with the cool water, the temperatures mentioned can create a satisfactory vacuum. At full load the locomotive has an average vacuum of from 80 to 90 per cent which increases at a lower load. It is possible under these circumstances to maintain a lower water temperature in the reservoir and begin the next period of heavy work with a better vacuum.

The heating and lighting systems

The exhaust of the auxiliary turbine on the tender, furnishes the necessary steam for heating the train at various pressures, according to temperature or other conditions. The turbine receives boiler pressure and the exhaust steam flows to the second feedwater heater drum in warm weather. Only that portion of the exhaust steam which is not used for train heating is supplied to the feedwater heater in cold weather. A small turbo-dynamo generates the necessary electric current for lighting.

Table of dimensions, weights and proportions of the turbine locomotive for the German State Railways

Railroad	German State Railways
Builder	I. A. Maffei, Munich, Germany
Type of locomotive	4-6-2
Service	Express
Main turbine speed at 74.6 m.p.h.	8,800 r.p.m.
Ratio of main reduction gear	1 to 24
Weights in working order:	
On drivers	132,000 lb.
On front truck	66,000 lb.
On trailing truck	31,000 lb.
Total engine	229,000 lb.
Total tender	150,000 lb.
Total engine and tender	379,000 lb.
Wheel bases:	
Driving	13 ft. 1 1/4 in.
Total engine	36 ft. 6 1/2 in.
Total engine and tender	69 ft. 9 in.
Diameter driving wheels outside tires	68.8 in.
Boiler:	
Type	Conical
Steam pressure	324 lb.
Fuel	Soft coal
Diameter, second ring, inside	64 3/4 in.
Length inside tube sheets	17 ft. 2 in.
Grate area	37.7 sq. ft.
Heating surfaces:	
Firebox	140 sq. ft.
Tubes and flues	1,580 sq. ft.
Total evaporative	1,720 sq. ft.
Superheating	549 sq. ft.
Comb. evaporative and superheating	2,269 sq. ft.

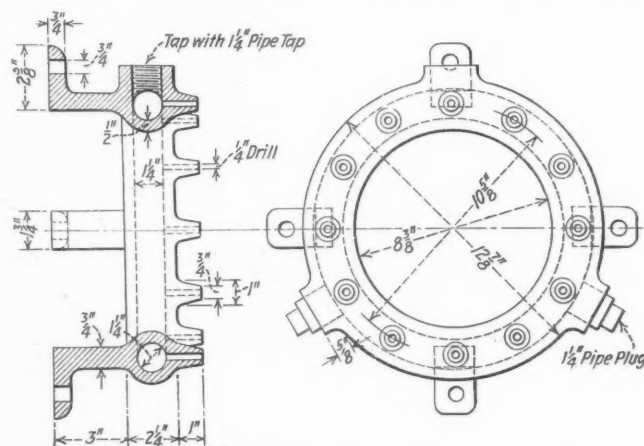
Tender:	
Capacity, cooling water tank	5,290 gal.
Capacity, feedwater reservoir	1,138 gal.
Fuel capacity	6 tons
Condenser:	
Total surface	2,370 sq. ft.
Water cooling installation:	
Cooling surface	16,150 sq. ft.
Rate of cooling air circulation 1,100 r.p.m. of fans	1,765 cu. ft. per sec.
Rate of cooling water circulation	12,700 cu. ft. per hr.
Floor space of cooler	122.8 sq. ft.
General data estimated:	
Horsepower	2,500
Weight proportions:	
Total weight engine ÷ horsepower	91.5
Total weight engine ÷ comb. heat. surface	101
Boiler proportions:	
Firebox heat. surface ÷ grate area	3.72
Firebox heat. surface, per cent of evap. heat. surface	8.14
Superheat. surface, per cent of evap. heat. surface	31.9

Locomotive blower pipe head

By H. H. Parker

Master mechanic, Norfolk & Portsmouth Belt Line, Portsmouth, Va.

THE Norfolk & Portsmouth Belt Line has been having successful results with a blower made of cast iron, the construction of which is shown in the drawing. The blower head casting has a 1 1/4-in. hole cored around the center of the ring through which steam passes from the blower pipe to twelve individual tips having 1/4-in. holes. The sand core is removed through three holes, two of which are plugged with 1/4-in pipe



Locomotive blower pipe head used by the Norfolk & Portsmouth Belt Line

plugs. The remaining hole is used as a connection for the blower pipe.

The head is provided with four legs, as shown in the drawing, the feet of which are drilled for bolting to the table sheet. All that is necessary to apply the head is to place it over the exhaust pipe, bolt it to the table and connect the blower pipe, which is clamped to the top of the table sheet. A ball joint union is used to connect the blower pipe to the head, which reduces to a minimum any possibility of the pipe breaking at the joint. The diameter of the blower head varies and is governed by the size of the smoke stack. The tip circle of the blower head used on our locomotives measures 10 5/8 in. in diameter. The diameter of the smoke stacks is 17 in. in the choke. We use a 1 1/4-in. blower pipe on locomotives having 22-in. diameter cylinders and a 1-in. blower pipe on smaller locomotives.



"Northern Pacific" (4-8-4) type passenger locomotive built by the American Locomotive Company

Locomotive and motor car orders in 1926

Year's orders continue to show tendency to depart from
conventional ideas in locomotive design

THE number of locomotives ordered in 1926 for domestic service in the United States totaled 1,301. This total is a slight increase over the 1,055 which were ordered in 1925, but is not as large as the number of locomotives ordered in 1924, 1923 and 1922, which show total figures of 1,413, 1,944 and 2,600 respectively. A total of 61 locomotives were ordered last year by Canadian railroads, these orders being distributed among 10 railroad and industrial companies. The Canadian Pacific ordered the largest number, 24 Pacific type and 20 Mikado type locomotives, while the Canadian National did not order any steam locomotives. This road, however, was the largest purchaser of locomotives during the two years preceding 1926, having ordered 56 locomotives in 1924 and five in 1925.

Of the 1,301 locomotives ordered in 1926, for service on the railroads of the United States, and Canada, 15 were Diesel-electric locomotives and 47 were electric locomotives. This is practically the same number of oil-electric locomotives that were ordered last year, there

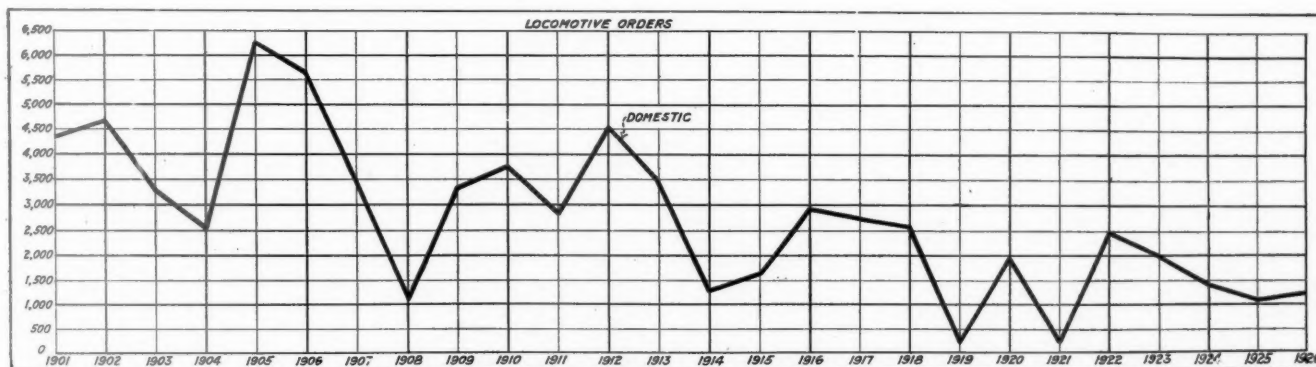
either locomotives or cars and little can be expected until conditions in that country become more settled.

The figures given in the various tables have been compiled from figures published in the January 1, 1927, issue of the Railway Age. These figures will not agree with the monthly totals furnished by the Car Service

Table I—Orders for locomotives since 1918

Year	Domestic	Canadian	Export	Total
1918.....	2,593	209	2,086	4,888
1919.....	214	58	989	1,170
1920.....	1,998	189	718	2,905
1921.....	239	35	546	820
1922.....	2,600	68	131	2,799
1923.....	1,944	82	116	2,142
1924.....	1,413	71	142	1,626
1925.....	1,055	10	209	1,274
1926.....	1,301	61	180	1,542

Division of the American Railway Association, due to the fact that the Railway Age figures cover all carriers, while those of the Car Service Division covers Class I railroads only and also because the latter's report in-



Locomotive orders, 1901 to 1926

being a total of 14 ordered in 1925. A graph shows the number of locomotives ordered for domestic service in the United States.

Export orders amounted to 180 in 1926, which is somewhat lower than in 1925, yet the number compares favorably with the orders placed in 1922, 1923 and 1924. No business was done with the Mexican railroads in

cludes, under installations, locomotives leased from other roads or rebuilt locomotives.

The largest number of locomotives were ordered by the Pennsylvania, a total of 375. Other large purchasers of equipment included the Southern, with 113 locomotives, followed in descending order by the Atchison, Topeka & Santa Fe, the New York Central, the Illinois

Central, the Louisville & Nashville and the Chicago, Rock Island & Pacific. All other orders were for less than 50 locomotives in 1926.

Types of locomotives ordered

The year 1925 saw the development of three new types; namely, the 2-8-4, the 4-10-2 and the 2-10-4. This tendency toward developments of new types did not diminish in 1926; witness, the 4-12-2 locomotive built by the American Locomotive Company for the Union Pacific, the Baldwin three-cylinder compound high-pressure

Table II—Important locomotive orders in 1926

	0-6-0	0-8-0	2-8-2	2-8-4	2-10-2	4-6-2	4-6-4	4-8-2	4-8-4	4-12-2
A. G. S.	4	8				4				
A. T. & S. F.		40		25			10		10	
B. & A.			20			5				
B. & O.						20				
C. C. C. & St. L.						10				
C. N. O. & T. P.	6	18				7				
C. R. I. & P.		35						15		
C. P.		20				24				
Fla. E. C.	12							33		
Ill. Cent.			50					20		
L. & N.		42						8		
M. C.	10					10				
M. St. P. & S. S. M.								10		
N. Y. C. & St. L.						4				
Nor. Pac.									12	
Penna.	60	40				75		200		
P. M.		10								
P. & L. E.						10				
S. A. L.	25									
Southern		12	20			12				
S. P.								5		
U. P.										15
Union	10									

locomotive No. 60,000, which was exhibited at Atlantic City during the A. R. A. conventions last June, and the Northern Pacific 4-8-4 type which was delivered in December, 1926. Another type, for which three orders were placed last year, is the 4-6-4, of which there are a total of 15 now being built, 10 by the Baldwin Locomotive Works for the Atchison, Topeka & Santa Fe, 4 by the American Locomotive Company for the New York, Chicago & St. Louis and one for the New York Central, also being built by the last named builder.

Shown in Table II is a summary of the more important

Table III—Types of locomotives ordered in 1926

Type	Railroad	Industrial	Export	Total
0-4-0	0	14	0	14
0-6-0	123	9	7	139
0-8-0	121	2	0	123
0-10-0	0	0	0	0
2-4-2	0	0	1	1
2-6-0	5	1	1	7
2-6-2	3	2	1	6
2-8-0	31	1	6	38
2-8-2	220	13	36	269
2-8-4	79	0	0	79
2-10-0	25	0	0	25
2-10-2	25	0	20	45
Mallet	17	2	0	19
4-6-0	2	0	4	6
4-6-2	193	0	38	231
4-6-4	15	0	0	15
4-8-2	326	0	38	364
4-8-4	22	0	0	22
4-10-2	32	0	0	32
4-12-2	15	0	0	15
Geared	0	8	0	8
Miscellaneous	56	9	28	93
	1,301	61	180	1,542

orders placed in 1926 grouped according to roads and types. This list includes 976 locomotives for 23 railroads or 71.8 per cent of the locomotives ordered by the railroads of the United States and Canada. The balance is in small orders from a number of railroads.

Table III shows a list of the locomotives which were ordered for the railroads, industrial concerns and for export. Similar information for the preceding year is given on page 89 of the February, 1926, issue of the *Railway Mechanical Engineer*. Of the total of 1,301 locomotives ordered by the railroads in 1926, 396, or 30.4 per cent,

were ordered for freight service and 605, or 46.5 per cent, were ordered for passenger service. These figures, however, do not show an exactly true proportion, for some railroads ordered locomotives to be used in either freight or passenger service; for example, the Florida

Table IV—Principal orders for 0-8-0 locomotives

Road	No.	Weight lb.	Tractive force, lb.
Indiana Harbor Belt*	3	286,000	87,700
Pennsylvania	40	278,000	76,154
Chicago & Western Indiana	5	261,000	63,600
Term. R. R. Assoc. of St. Louis	8	247,500	60,335
Chicago & Illinois Western	2	221,400	51,041
Michigan Central	10	220,000	50,000
Kentucky & Indiana Terminal	6	219,000	55,500
Florida East Coast	12	218,500	51,000
Cincinnati, New Orleans & Texas Pacific	6	214,000	53,500
Southern	12	214,000	53,500

* Three-cylinder.

East Coast order for 33, 4-8-2 type locomotives, and the Pennsylvania's order for 200 locomotives of the same type. Locomotives having four-wheel engine trucks are considered as belonging in the list of passenger locomotives in arriving at the above figures.

A total of 244 locomotives were ordered for switching service by the railroads in 1926, as compared with 155 in 1925. The orders were fairly evenly divided between the 0-6-0 and 0-8-0 types, which has not been the case for

Table V—Principal orders for 2-8-2 locomotives in 1926

Road	No.	Weight lb.	Tractive force, lb.
Chicago, Rock Island & Pacific	28	351,000	63,466
Atchison, Topeka & Santa Fe	7	347,000	63,466
Chicago, St. Paul, Minn. & Omaha	30	337,880	63,000
Canadian Pacific	8	336,000	63,000
Chicago, Indiana & Louisville	20	335,200	57,100
Alabama Great Southern	6	327,000	63,000
Southern	8	326,000	59,900
Chicago, New Orleans & Texas Pacific	20	326,000	59,900
Louisville & Nashville	18	326,000	59,900
Pere Marquette	42	323,000	63,000
	10	312,000	54,700

a number of years. The orders for the 0-8-0 type in 1925 greatly exceeded the orders for the 0-6-0, there being 132 of the former, as compared with only 22 for the latter type, and the same situation occurring in 1924 and 1923, when there were 295 and 132 0-8-0 type locomotives ordered, respectively. The largest order for switch engines was placed by the Pennsylvania, of which 60 were of the 0-6-0 type and 40 of the 0-8-0 type. The entire 100 were built in the company shops. The Seaboard Air Line ordered 25 of the 0-6-0 type and the Union ordered 10. In addition to the 0-8-0 types ordered by the Pennsyl-

Table VI—Principal orders for 4-8-2 locomotives in 1926

Road	No.	Weight lb.	Tractive force, lb.
Delaware, Lackawanna & Western*	25	394,000	77,600
Pennsylvania	200	381,250	64,550
New York, New Haven & Hartford*	10	374,000	60,000
Illinois Central	20	367,500	51,121
Chicago, Rock Island & Pacific	15	365,000	50,430
Florida East Coast	23	360,000	60,500
Minn., St. Paul & Sault Ste Marie	10	319,500	44,000
Louisville & Nashville	8	334,240	53,900

* Three-cylinder.

vania, 12 were ordered by the Southern and also the Florida East Coast, 10 by the Michigan Central and 4 by the Alabama Great Southern.

Of the locomotives with two-wheel engine trucks and three, four or five pairs of drivers, locomotives of the 2-8-2 type, were ordered in the largest numbers last year. In this group are 220, or 16.9 per cent of the total. The

next largest group is the 2-8-4 type, of which there are 70 or 5.4 per cent of the total. Roads which placed the largest orders for the 2-8-2 type were the Louisville & Nashville with 42, and the Chicago, Rock Island & Pacific with 35. The Illinois Central ordered 50 of the 2-8-4 type.

A survey of the orders for locomotives having four-wheel engine trucks and three, four or five pairs of drivers also shows that the four-coupled locomotives appear to be better suited for service on the majority of railroads. Of this group, the 4-8-2 type shows the preponderance of orders, there being 326 of this type, or 25 per cent of the total. Of course, one reason for so large a number of this type being ordered is that some roads have found the 4-8-2 type suitable for both freight and passenger service. The next largest number ordered in this group was for the 4-6-2 type, of which there were 193 ordered, or 14.8 per cent of the total. The largest number of this type was 75 ordered by the Pennsylvania. The Canadian Pacific ordered 24 and the Baltimore & Ohio ordered 20.

Tendencies as to size

An idea of the size of locomotives required to meet present day operating conditions may be obtained by referring to Tables IV to VI, inclusive, in which important orders for the leading types placed last year are grouped according to weight.

The majority of the locomotives of three-cylinder design ordered in 1926 were of the 4-8-2 type, of which there was a total of 35. Twenty-five of these were ordered by the Delaware, Lackawanna & Western, and 10 by the New York, New Haven & Hartford. A total of 32 three-cylinder 4-10-2 type locomotives were ordered last year, of which 23 were ordered by the Southern Pacific, and 9 by the Los Angeles & Salt Lake. Four three-cylinder eight-wheel switchers were also ordered last year, one by the Alton & Southern and the remaining three by the Indiana Harbor Belt. Referring to Table IV, it will be noted that the three-cylinder switch engines of the last named road weighs 286,000 lb. as compared with the next heaviest, the two-cylinder 0-8-0 type locomotives for the Pennsylvania, which weigh 278,000 lb. The three-cylinder locomotives listed in Table VI do not differ materially from the average weight of some of the 4-8-2 type locomotives of two-cylinder design.

The Union Pacific 4-12-2 type is one of the outstanding

Comments on design

The developments of outstanding interest in design which have appeared during the past year are the "Union Pacific" type, 4-12-2, built by the American Locomotive Company, the Baldwin three-cylinder compound, high-

Table VIII—Orders for rail motor cars and trailers

	1922	1923	1924	1925	1926
For service in the United States..	51	77	120	149	158
For service in Canada.....	7	3	12	7	4
For export	1	22	..	34	32
Total.....	59	102	132	190	194
Motor cars.....	50	93	112	171	170
Trailers	9	9	20	19	24

pressure locomotive, and the Northern Pacific, 4-8-4. Four 4-6-4 types now being built for the Nickel Plate, and one is being built for the New York Central, by the American Locomotive Company. Ten locomotives of the 4-6-4 type are also being built for the Santa Fe by the

Table IX—Number, type and weight of rail motor cars ordered in 1926 for service in the United States and Canada

Builder	Type of power plant	No. motor cars	Horse-power	Nominal weight, lb.
J. G. Brill Co.	Gas-electric..	14	250	90,000
	Gasoline	5	70	30,000
	Gas-electric..	1	175½	86,000
	Gas-electric..	9	500	125,000
	Gasoline	2	190	55,000
	Gas-electric..	5	250	103,000
	Gas-electric..	3	280	92,000
J. G. Brill Co. and Ottawa Car.	Gas-electric..	2	250	.....
Electro-Motive Co.	Gas-electric..	5	440	116,000
Electro-Motive-St. Louis Car.	Gas-electric..	5	125	113,000
	Gas-electric..	23	275	96,000
	Gas-electric..	18	220	90,000
	Gas-electric..	11	220	78,000
	Gas-electric..	2	105	94,000
Osgood-Bradley-Electro-Motive	Gas-electric..	10	250	100,000
Standard Steel	Gas-electric..	4	440	107,000
Edwards	Gasoline	4	100	18,000
	Gas-electric..	2	100	34,000
American Car & Foundry.....	Gas-electric..	2	500	125,000
Bro. Weller & Kissel.....	Gasoline	1	50	20,000
Railway Motors Corp.....	Gasoline	4	208	90,000
Meister Co.	Gasoline	2	60	20,000
New York Central*.....	Oil-electric ..	1	200	179,000
Total.....		159		

* Company built.

Baldwin Locomotive Works. The designers of the Union Pacific type utilized a six-coupled driving wheel base. In doing this they took advantage of the distribution of driving stresses among three cylinders and main rods and

Table VII—Oil-electric or Diesel-electric locomotives ordered in 1926

Purchaser	No.	Wheel arrangement	Service	Weight	Tractive force	Cylinders No. Dia. and stroke	Builders
Chicago & North Western.....	1	0-4-4-0	Sw.	120,000	.....	.....	Ingersoll Rand-Amer.-Gen. Elec.
	1	.....	Sw.	120,000	.....	.....	Ingersoll Rand-Amer.-Gen. Elec.
Erie	1	.....	.....	120,000	.....	.....	Ingersoll Rand-Amer.-Gen. Elec.
Great Northern	1	3-4-4-0	Sw.	200,000	.....	.....	Ingersoll Rand-Amer.-Gen. Elec.
Ingersoll Rand	1	.....	.....	120,000	.....	.....	Ingersoll Rand-Amer.-Gen. Elec.
Inland Steel	1	0-4-0	Sw.	120,000	.....	.....	Ingersoll Rand-Amer.-Gen. Elec.
Long Island	2	0-8-0	Frt.	203,000	60,000	.....	Ingersoll Rand-Amer.-Gen. Elec.
New York Central.....	1	4-8-4	.....	234,000	.....	.....	Ingersoll Rand-Amer.-Gen. Elec.
	1	4-8-4	.....	268,000	.....	.....	McIntosh & Seymour-Amer.-Gen. Elec.
	1	4-4-4	Frt.	268,000	.....	.....	New Lon. S. & E.-Gen. Elec.-Amer.
Lehigh Valley	1	0-4-4-0	Sw.	152,000	40,000	6-8 x 9½	McIntosh & Seymour-Gen. Elec.-Brill.
Reading	1	.....	.....	120,000	36,000	.....	Ingersoll Rand-Amer.-Gen. Elec.
Red River Lumber Co.....	1	.....	.....	200,000	.....	.....	Ingersoll Rand-Amer.-Gen. Elec.
Utah Copper	1	.....	.....	120,000	.....	.....	Ingersoll Rand-Amer.-Gen. Elec.

developments in locomotive design during 1926, and is also of three-cylinder construction. This locomotive, a description of which was published in the July, 1926, *Railway Mechanical Engineer*, has a total weight of 495,000 lb. and a tractive force of 96,650 lb. The first locomotive of this design was delivered on April 9, 1926, and an order for 15 more were placed with the builders in the following month.

among three main crank pins on two axles, thereby securing a unit of unusually large capacity for a non-articulated locomotive.

The Baldwin locomotive No. 60,000, a 4-10-2 type, is of unusual interest because of its working pressure of 350 lb. and its use of the double expansion principle in a three-cylinder arrangement. The firebox of this locomotive is a modified Brotan water-tube type, with 82 sq. ft.

of grate area and a portion of the firebox set off by a fire wall to form a combustion chamber. The boiler efficiency of this locomotive ranges from 52 per cent, at a boiler output of 85,000 lb. equivalent evaporation per hour, to 70 per cent, at outputs of approximately 30,000 lb. per hour. This is not unusual, but the low steam and coal consumption per indicated horsepower-hour is evidence of the value of the increased boiler pressure, which makes possible the conversion into work of a larger pro-

Table X—Comparison of rail motor car weights, United States and Canada

Weights	1926	1925
25,000 lb. and under	7	6
Over 25,000 lb. to and including 50,000 lb.	7	19
Over 50,000 lb. to and including 75,000 lb.	2	74
Over 75,000 lb. to and including 100,000 lb.	79	27
Over 100,000 lb.	38	9

portion of the total amount of heat in each pound of steam than is possible with a boiler working pressure of 200 lb. per sq. in.

Diesel locomotives

A total of 15 oil-electric and Diesel-electric locomotives were ordered for domestic service in 1926. A list of these locomotives is shown in Table VII. Twelve of the units ordered last year have Ingersoll-Rand oil engines, two have McIntosh & Seymour engines and one has a New London Ship & Engine Company engine. The heaviest locomotives of this class ordered last year are the 4-8-4 and 4-4-4 types ordered by the New York Central, both of which weigh 268,000 lb.

Increase in rail motor car orders in 1926

There has been a yearly increase in the number of rail motor cars and trailers ordered by the railroads since 1922, although the increase in 1926 is not large numerically. Beginning with 51 cars ordered in 1922, for use in the railroads in the United States, orders for 77 were placed in 1923; for 120 in 1924, and for 149 in 1925. Orders were placed for 158 motor cars and trailers by the railroads of the United States during 1926. A com-

Table XI—Power plant capacity of rail motor cars, United States and Canada

Horsepower	1926	1925
100 or less	14	13
Over 100 to and including 125	7	5
Over 125 to and including 150	..	9
Over 150 to and including 175	1	20
Over 175 to and including 200	3	49
Over 200 to and including 250	65	36
Over 250 to and including 300	26	2
Over 300	19	2

parison of the total number of cars ordered, both for use in the United States and Canada and for export, from 1922 to 1926, inclusive, is shown in Table VII, and the number, type and weight of rail motor cars ordered in 1926, for service in the United States and Canada, classified according to builders, is shown in Table IX.

Since the beginning of the use of rail motor cars, the trend from year to year has been uninterruptedly toward the use of heavier cars with power plants of larger capacity. Just how these trends have been operating during 1926, as compared with 1925, is set forth in Tables X and XI, in which all of the motor car units for which the data are complete have been classified in groups representing ranges of weights and horsepowers, respectively.

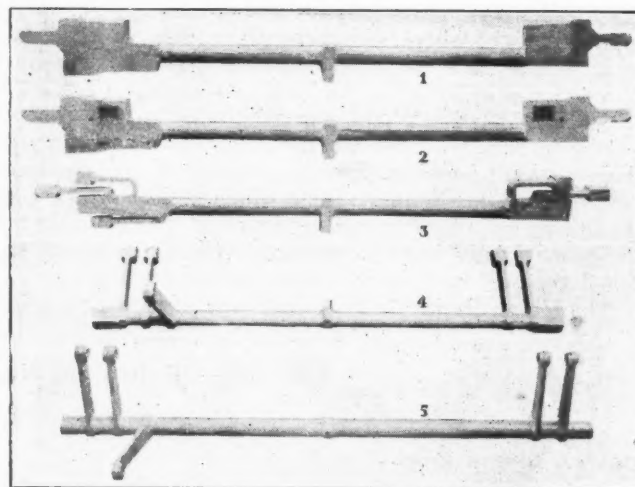
It will be seen that while the weight of the largest number of cars ordered during 1925 fell between 50,000 lb. and 75,000 lb., the largest number in 1926 is in the 75,000-lb. to 100,000-lb. group. Furthermore, it will be seen that there has been a marked increase in the number of

cars ordered with weights of over 100,000 lb. Considering the power plant capacity, 20 of those ordered in 1925 fell within the 150-hp. to 175-hp. group; 49 in the 175-hp. to 200-hp. group, and 36 to the 200-hp. to 250-hp. group. For 1926, by far the larger proportion of the motor cars ordered have power plants of over 200-hp. capacity, 65 of these falling between 200 and 250 hp., 26 between 250 and 300 hp., and 19 over 300 hp. Included in this last group are several orders for cars with power plants having capacities of 440 hp. and 500 hp.

These large power plants and the relatively high weights accompanying them mark a steady growth in the rail motor car field from the original idea of single units for light branch line service, into the steam passenger train field, of several car trains. All of the larger cars are designed to handle at least one trailer and those with the higher capacity power plants are designed to handle more than one trailer. The trend in the use of trailers is brought out in Table VIII.

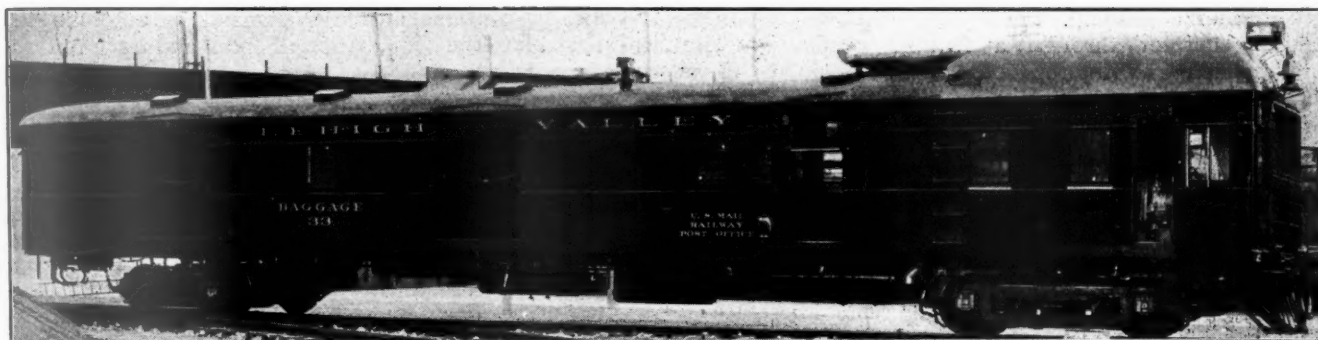
Forged reverse shaft on Wabash switchers

AN interesting example of what can be accomplished by modern forging methods is the way in which the reverse shafts for some eight-wheel switchers on the Wabash were manufactured. The reverse shaft was made in one piece from a billet 6 in. by 14 in., weighing 1,200 lb. The billet was first forged to the shape shown in Fig. 1 of the illustration. It was then laid out for blocking out the arms, being first drilled as shown in Fig. 2 and then slotted out, leaving the forging as



The consecutive steps taken in making a finished reverse shaft from a single forging

shown in Fig. 3. The body of the shaft between the arms was then turned and the counter-balance lug faced off, after which it was returned to the blacksmith shop where the arms are bent as shown in Fig. 4. This permitted the turning of the shaft between the arms. The shaft was again returned to the blacksmith shop where the arms were bent to their proper position at right angle to the shaft, and the shaft was twisted so as to bring the reach rod arm at right angle to the lifting arms as indicated in Fig. 5. The remainder of the machine work consisted of turning and facing the ends of the shaft, finishing the arms and drilling, resulting in the completed shaft shown in Fig. 5.



Seventy-foot mail and baggage motor car, driven by two 250-hp. gasoline-electric power plants

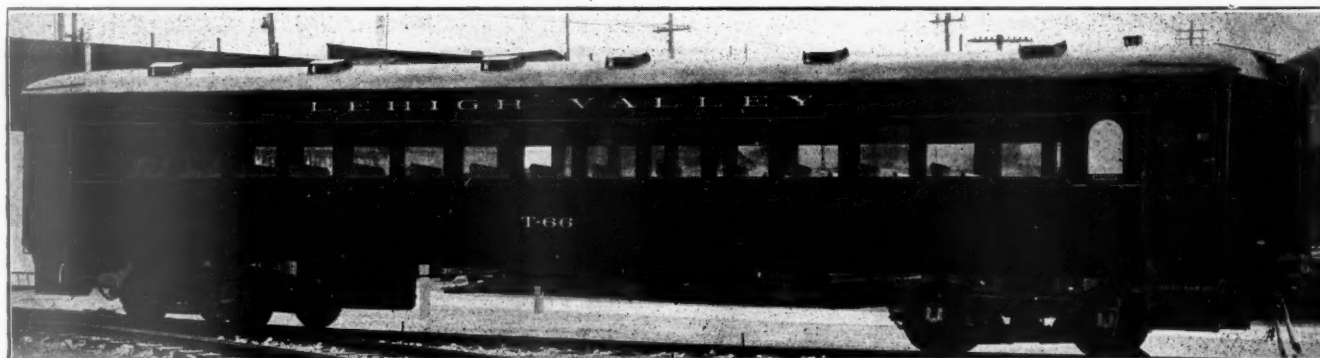
Double power plant motor cars on the Lehigh Valley

Four Brill 500-hp. units handle maximum trains of over 300 tons in local service

THE Lehigh Valley has recently placed in service four large Brill gas-electric motor cars built by the J. G. Brill Company, Philadelphia, Pa. Each motor car carries two power plants, each consisting of a 250-hp. Brill-Westinghouse gasoline motor, direct connected to a Westinghouse 160-kw. generator. Both trucks are equipped with motors. The motor cars are 70 ft. 6 in. long over buffer plates and weigh approximately 130,000 lb. The passenger trailers, one of which will operate with each motor car, are 57 ft. 6 in. long over

constant succession of sharp curves and some grades of considerably more than two per cent.

Four different floor arrangements are represented in the four motor cars and two arrangements in the trailer cars. The two motor cars operating on the Bowman's Creek branch carry on passengers, one being devoted entirely to baggage and express and the other having a standard 15-ft. mail compartment back of the engine room. The other two cars have smoking compartments 11 ft. 8 in. long with seats for 19 passengers. One of



One of the motor trailers, which seats 78 passengers

the vestibules and seat either 76 or 78 passengers. They weigh approximately 59,000 lb. each.

Two of the new cars are operating between Elmira, N. Y., and Canastota, a distance of 18.4 miles, where at times they will be required to handle either an extra express car or a steel coach, a weight varying from 53 to 73 tons, in addition to the single passenger trailer which forms a regular part of the train. The other two cars operate between Wilkes-Barre, Pa., and Towanda, via the Bowman's Creek branch, where under the most severe conditions they will be required to handle as many as four loaded milk cars weighing about 228 tons, in addition to the regularly included passenger trailer. The profiles on both lines are severe, the Bowman's Creek branch having numerous grades of two per cent, with a

them is equipped with a 15-ft. mail compartment, while the other carries only baggage and express.

The power plant and control equipment

The trailers which operate with the non-passenger carrying motor cars are divided into two compartments, the smoking room seating 23 passengers and the main compartment seating 53 passengers. Where a smoking room is provided in the motor car, the passenger trailer is undivided and seats 78 passengers. The passenger accommodations in all cases are fitted with 55-in. seats on one side of the aisle, to seat three passengers, and 35-in. seats on the other side, to seat two passengers, with a 22-in. aisle space between.

Each power plant consists of a 250-hp. Brill-Westing-

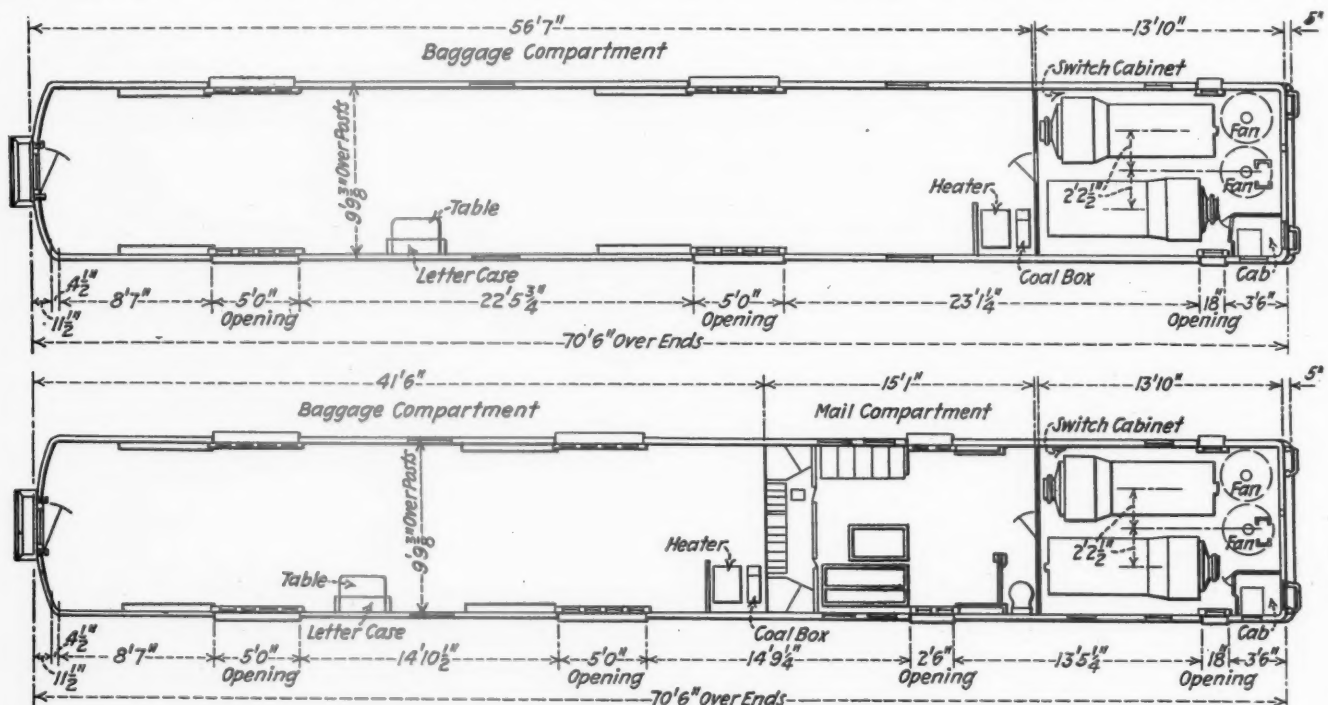
house engine driving a 600-volt 160-kw. Westinghouse generator through a flexible coupling. The unit, complete with the exciter, is mounted on a common bed-plate. The two power plants are mounted longitudinally in the engine room and spaced 4 ft. 5 in. between center lines. This arrangement permits access to either side of either unit and gives an aisle between to permit entry and exit from the engine room. A removable panel on each side of the engine room provides for the installation and removal of the complete unit. One of the units is mounted with the generator facing forward and the other facing backward. This arrangement permits a greater aisle width and places a large proportion of the engine auxiliaries on the aisle side where they can be inspected with a minimum of effort.

The engine is a vertical four-cycle gasoline type. It has six cylinders with $7\frac{1}{2}$ -in. bore and 8-in. stroke. It is equipped with dual valves and ignition and is governed at 1,100 r.p.m., at which speed it will deliver 250 hp.

practically constant and this demand is automatically translated into the combination of speed and tractive force necessary at the motors. The exciter is an integral part of the generator, having its armature on the extended generator shaft and its frame bolted to the commutator end generator housing. It performs the functions of exciting the generator, charging the storage battery and providing part of the energy for the lights.

There are two Westinghouse type 557-D-8 motors on each truck and the trucks are fed separately, one from each generator. The motors have a nominal rating of 140 hp. and will be applied with the maximum gear reduction. This results in maximum tractive force per ampere, and the high generator voltage available at low current values also allows high schedule speed to be maintained. Motor cut-out switches are provided to enable either pair of motors to be cut out in case of trouble.

The control is the Westinghouse unit switch type, arranged for single-end operation and housed in a cabi-



Floor plans of the motor cars for the Bowman's Creek branch

continuously. It is arranged with four overhead valves per cylinder and equipped with removable cylinder sleeves and a seven-bearing crankshaft, 4 in. in diameter. Lubrication is by full high pressure to all main connecting rod, camshaft, idler gear, and rocker arm bearings. A gear type pump delivers oil under high pressure to the header extending along one side of engine. Drilled leads supply the camshaft bearings on this side and copper pipes supply the oil to the overhead valve gear and main bearings Nos. 1, 3, 5 and 7; the oil passes through the crankshaft to the adjacent rod bearings and to the remaining main bearings Nos. 2, 4 and 6. From these latter bearings the leads connect to the header along the opposite side of the engine, from which drilled passages carry the oil to adjacent camshaft bearings. The oil pressure relief valve is connected to this header and discharges surplus oil into the gear case. The pressure is proportional to the load on the engine and is 50 lb. per sq. in. with wide open throttle.

By suitably proportioning the magnetic circuits and field windings, the generator demand upon the engine is

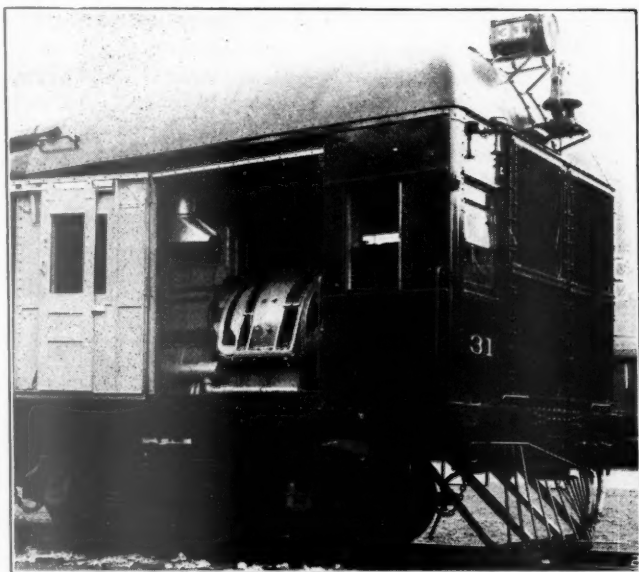
net in the engine room. This type of control is electrical-ly controlled and pneumatically operated, making the operation of a double unit equipment as easy as that of a single unit. The duties of the operator have been reduced to a minimum by the use of remotely controlled apparatus and by reducing the amount of manual control apparatus as much as possible. No high voltage current-carrying apparatus is near the motorman, as it is contained in an asbestos-lined switch cabinet. The rapid and positive opening and closing of the switches greatly reduces the arcing and burning, thereby prolonging the life of the apparatus.

The application of power to the motors is governed by the throttle handle, which also serves as a master controller. Movement of the throttle handle from the "off" position first closes a toggle switch which governs the closing of the field and line switches. Further movement of the throttle handle changes the engine speed which, in turn, changes the car speed correspondingly.

Series-parallel control of the motors has been provided and is governed by the position of a tumbler switch in

the operator's compartment. A special feature of the series-parallel arrangement used is the fact that the tumbler switch may be used to pre-select the motor connection while the car is drawing power. When the operator wishes to make the actual change, the only action necessary is to return the throttle handle to the "off" position and immediately return it to its former position. This method reduces to a minimum the time lost in changing the motor connections and assists in maintaining a higher average accelerating rate and a higher schedule speed. Separate ignition switches for the two engines permit the use of either one alone in case trouble should develop in either power plant.

The direction of motion of the car is governed by a



The engine room, with the removable side panel swung open

plug switch with two receptacles, placed near the operator. The insertion of the plug in the proper receptacle establishes electrical connections to throw the reversers to the desired position. An ammeter, placed in each generator circuit, enables the operator to take full advantage of all the power available without overloading any of the apparatus.

Air to operate the brakes, control, etc., is furnished by two Westinghouse 600-volt, motor-driven air compressors, each having a displacement of 25 cu. ft. at rated voltage. The compressor motors operate in parallel, being connected directly across either generator by means of a double-pole, double-throw switch.

Since the cars are for single-end operation, the radiator is mounted at the front and is divided into four sections. It is set at the left of the end of the car to provide room at the right for the operator's compartment. Immediately at the rear of the radiators is an air chamber closed on the bottom and sides, but with an opening at the top. In this opening, slightly above the top of the radiator, are two fans mounted side by side in a horizontal plane and each driven by a shaft projecting downward to a vertical motor placed on the car floor. Parallel and series connections provide two speeds for the fans.

To assist in the movement of the air which is driven upward by the fans of the motor cooling system, a shroud or false roof is placed over the front of the car, extending back about eight feet and open at the rear. The air is forced into the space between the two roofs at the front and then will travel back towards the outside air. The expansion water tank is so located in

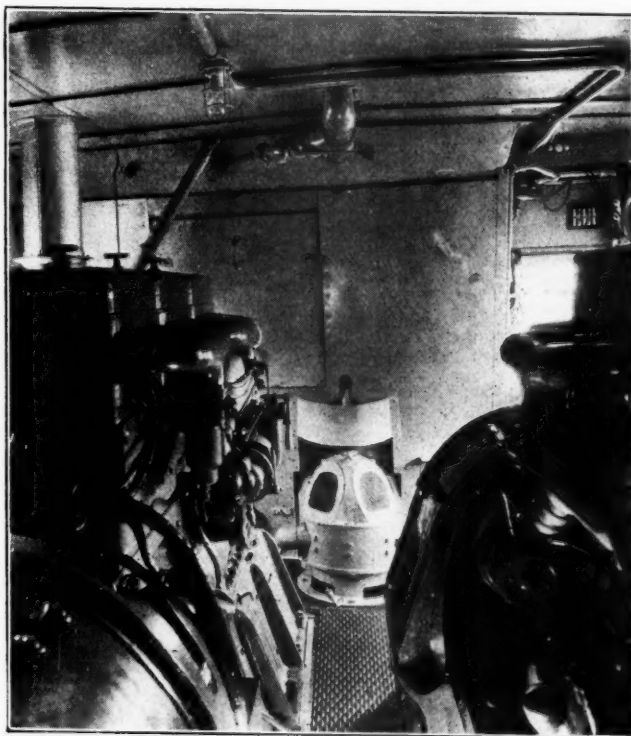
this space that the air exhausted by the fans will pass over the tank. The exhaust pipes come through the roof into this space with the mufflers mounted back of the shroud.

Fuel is supplied to the engine by the vacuum feed system to two carbureters on each engine. The fuel supply is carried in two 150-gal. tanks under the car floor. These tanks are connected with an equalizer pipe so that both can be filled at the same time from one side of the car.

Construction of the cars

Both the motor cars and the trailers are essentially of all steel construction. The underframes are built up on center sills of 10-in. channels which extend continuously from end sill to end sill. The side sills are 4-in. by 4-in. by $\frac{3}{8}$ -in. angles which also extend for the full length of the cars and the bolsters are of the built-up type. The end sills and other cross members are composed of channels which are securely riveted to the side and center sills with angle brackets.

The corner posts of the car body frame are of pressed steel, while the side posts are 2-in. by 2-in. by $\frac{1}{4}$ -in. by $\frac{5}{16}$ -in. rolled steel tees. These are riveted to the side sills at the bottom and to the 4-in. 8.2-lb. Z-bar side plates at the top. The belt rail is a $\frac{3}{2}$ -in. by $\frac{1}{2}$ -in.



Looking forward in the engine room—One of the cooling fan motors can be seen at end of the aisle between the power plants

flat steel bar, riveted to the side posts below the window sills. It is covered with a 16-gage pressed-steel window sill cap. On the trailers, the top rails are $2\frac{1}{2}$ -in. by 2-in. by $\frac{1}{4}$ -in. angles. On all of the cars the side posts are encased with wood.

Both the letter panel and the side sheathing are of $\frac{3}{32}$ -in. patent leveled sheet steel and the joints in the side sheathing are covered with splice plates of the same material.

The roofs are of the plain arch type, supported by $1\frac{1}{2}$ -in. by $\frac{3}{8}$ -in. steel bar carlines to which the wood cross members are secured. The roof is of $\frac{7}{16}$ -in.

poplar boards, tongued and grooved and is covered with No. 8 canvas, bedded in white lead. The cars are insulated throughout with $\frac{3}{4}$ -in. three-ply insulating material, except the floors of the baggage and engine rooms.

In all passenger and baggage compartments, a double floor is laid. The bottom floor is of $\frac{5}{8}$ -in. tongued and grooved fir, laid crosswise. In the passenger and mail compartments this floor is covered with three-ply Salamander insulation and over this, with a 1-inch air space between, is laid a $\frac{13}{16}$ -in. maple floor with the boards running lengthwise. In the baggage compartment two-ply Salamander is placed over the bottom floor and a top floor of $\frac{15}{16}$ -in. yellow pine is laid with a $\frac{1}{2}$ -in. air space between the two floors. The floors in the engine rooms and vestibules are a single course of $1\frac{5}{16}$ -in. yellow pine, and are installed without insulation.

The trailers and the motor cars in which smoking compartments are located, all have vestibules 3 ft. $11\frac{1}{2}$ -in. long at the diaphragms, with side and trap doors over the steps, the openings of which are 2 ft. $2\frac{5}{8}$ -in.

at each end. The trailer trucks are of light construction with 6 ft. 6 in. wheel base, fully equalized. The axles are of the A. R. A. type with friction bearings and carry 33-in. rolled steel wheels.

The cars are equipped with light-weight bottom-operated couplers manufactured to the standard A. R. A. contour and having 4-in. by 5-in. shanks. They are fitted with spring draft gears using A. R. A. Class G springs in each yoke. The cars are equipped with Westinghouse automatic air brakes with the straight air feature on the motor cars.

Each car is equipped with a 16-cell storage battery, to supply engine starting current, to energize the exciter field and to provide lighting. It will be charged normally by the exciter although a receptacle will be provided in order that an external charging source may be used if desired.

These cars, which have been in service for varying periods of a month or more, have been received with every evidence of satisfaction by the patrons of the lines which they serve. The normal crew consists of a motorman, baggageman and conductor. The cars main-



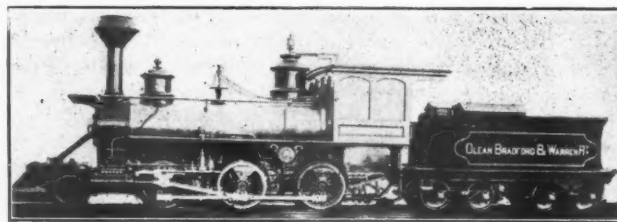
Interior of one of the passenger trailers, with the smoking compartment in the foreground—Seating capacity 76 passengers

wide. The rear ends of all of the motor cars and both ends of the trailers are fitted with two-stem platform buffers and are also equipped with Morton single-fold vestibule diaphragms.

Each motor car and trailer is equipped with a hot water heater with radiation from two lines of $2\frac{1}{2}$ -in. pipe on each side of the car. The windows in all passenger compartments are fitted with removable storm sash. On all of the motor cars connections will be made between the car heater and the engine radiator system in order that it will be unnecessary to drain the radiators at the end of each trip, and to facilitate starting the engines in cold weather after they have been standing idle for some time.

The motor trucks are of the Brill high speed type, equipped with solid forged side frames, equalizers and side swing dampeners. The front truck, which carries the heavier load, has a wheel base of 7 ft. 9 in. and is fitted with four elliptic bolster springs at each side. The wheel base of the rear motor truck is 7 ft. 6 in. and this truck is fitted with three elliptic bolster springs

tain their schedules as well as did the steam locomotives which they replaced and have developed no operating difficulties more than are to be expected with the introduction of a new class of equipment until the operating organization has time to become thoroughly familiar with it.



Olean, Bradford & Warren locomotive No. 3, "State Line," built in 1878—Gage 3 ft.; cylinders, 12 in. by 18 in.; diameter of drivers, 36 in.

Mechanical engineers in the railroad industry*

Only three presidents and five vice-presidents have been promoted from mechanical department

REALIZING that many mechanical engineers have a pessimistic viewpoint as to the opportunities afforded them in railroad work; that the industry is evidently not getting its proper share of the better mechanical engineering talent from the technical schools, and that many mechanical engineers eminently fitted for railroad work are entering other fields of endeavor, the Railroad Division, A. S. M. E., is undertaking the collecting and assembling of facts and information, with the following primary objects in view:

1—To assemble facts pertaining to the railroad and railway supply industries in order to assist the young mechanical engineer to a knowledge of the industry as it affects him personally.

2—To give technical schools and colleges a source of reliable and accurate information with which they can be of service to students contemplating entering railroad or railway supply work.

3—To have available for the members of the American Society of Mechanical Engineers a source of fact information with which the Society as an organization or its individual members can render real service to the young mechanical engineer.

The scope of the sub-committee's work includes both the railroad and railroad supply industries. Approximately 43 per cent of the executive and technical officers and sales staff of railway supply concerns promoted since December, 1919, have been recruited from the railroads. It is estimated by reputable authority that for every man in railway service, there is another at work making materials the railroads buy. It is, then, quite natural that railroad supply industry should select good men for its executive and sales staff from the railroads. Therefore, the work of the sub-committee would not be complete without considering both industries.

Facts relative to the railroad industry—Comparison with other industries

There are 1,023 railroads in the United States and Canada, about 190 of which are Class I railroads. The Class I railroads operate approximately 90 per cent of the total railway mileage in the United States and earn about 96 per cent of the total revenues. According to the Monthly Labor Review, published by the Bureau of Labor Statistics, there were employed during one week in July, 1926, a total of 1,816,818 men and women. A

Table I—Comparison of employment in 13 general groups of industries, during one week, July, 1926*

	Number of establishments	Average number of wage earners
Railroads	Total Class I	1,816,818
Iron and steel, and their products	1,815	688,471
Textiles and their products	1,858	546,560
Vehicles for land transportation	971	483,843
Miscellaneous industries	408	264,375
Lumber and its re-manufacturers	1,048	209,582
Food and kindred products	1,460	206,535
Paper and printing	880	164,157
Leather and its finished products	368	119,790
Stone, clay and glass products	638	112,084
Chemicals and allied products	277	87,459
Tobacco manufacturers	199	43,256
Metal and metal products, other than iron and steel	206	49,578

* Monthly Labor Review.

* Abstract of a progress report presented by the Sub-Committee on Professional Service of the Railroad Division at the annual meeting of the American Society of Mechanical Engineers, December 7, 1926.

comparison of this figure with the number employed by other industries during the same period is given in Table I. The second largest industry, according to the number employed, is the iron and steel industry, the textile industry being third.

Figures showing the proportion of technical graduates, and for our purposes mechanical engineers, to the total number employed, would be of value in this table. The sub-committee has not, however, found any source from which such information could be obtained. A general idea of the number of supervisory positions in which mechanical engineering training would be of service is

Table II—Number of employees holding positions where mechanical engineering training would be of service, June, 1926, on Class I railways in the United States*

Executives, general officers and assistants	7,431
Division officers, assistants and staff assistants	9,372
Architectural, chemical and engineering assistants	7,377
Subprofessional engineering and laboratory assistants	3,968
General foremen (M. of E.)	1,466
Total	29,614

* Includes 16 switching and terminal companies. Data obtained from Wage Statistic Report, Interstate Commerce Commission.

shown in Table II. Care should be used, however, in the use of the total figure due to the fact that many of the executives and staff officers fill positions requiring legal, medical or business training. Furthermore, this total does not include special apprentices or minor mechanical department officers.

Being president of a railroad is, of course, not strictly an engineering position, but there are ambitious young mechanical engineers who are aiming for such a position. An analysis of the careers of the presidents of the more important Class I railroads contains much information of interest and value. Table III contains an analysis of the

Table III—Careers of the presidents of 79 Class I railroads

	Total	Common school	High school or equivalent	College grad.	College Grad. per cent
Education, total	79	33	12	34	43
Dept. in which trained					
Executive, financial, legal... ..	63	29	6	28	44.4
Accounting	4	3	1	0	0
Traffic and claims	13	8	4	1	7.7
Operating and telegraph	42	22	9	11	26
Purchasing	5	2	2	1	20
Mechanical	3	2	0	1	33
Engineering, bridge and signal departments	25	9	2	14	56

careers of the presidents of 79 Class I railroads. Out of the 79 presidents, 34, or 43 per cent, are college graduates, 12 had a high school or equivalent education and 33 had only a common school education. The figures shown in the left hand column for those who worked in various departments will total more than 79, because the majority worked in several departments before becoming presidents. Only three railroad presidents out of the 79 have worked in the mechanical department, the three being Gen. W. W. Atterbury of the Pennsylvania, H. J.

German of the Montour and Henry Miller of the Terminal Railroad Association of St. Louis. The principal facts to be obtained from this analysis is that the mechanical engineer must compete for executive positions with men trained not only in the other engineering professions, but in the legal profession and in business as well.

Table IV shows the results of a study made of the railroad careers of 25 railroad officers in six different grades. The right hand column of the table shows the number of years gained by the college graduate in reaching each position listed, in comparison with the time required by the non-college man to reach the same position as well.

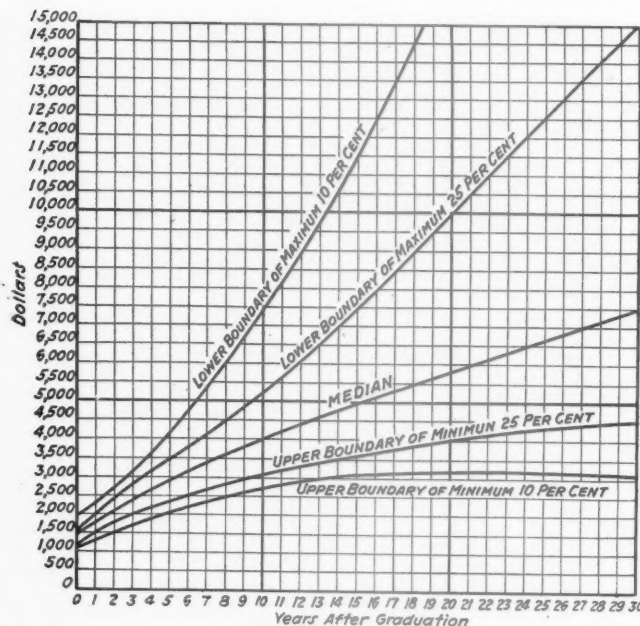


Chart showing the earnings of engineers in all industries by years after their graduation from universities and colleges

tion. The officers, selected at random, are all employed by Class I railroads. The average age of the superintendents of motive power selected, the highest position on a railroad requiring mechanical engineering training, is 43.8 years. By taking the average time spent in railroad service by the college-trained officer and the time

Table IV—Average ages of 25 officers in each grade shown. Time required to reach certain positions and time gained by college graduates

	Average age	Avg. time in R. service	College trained, per cent	Average time for non-college man	Avg. time for college graduate	Time (yrs.) gained by college graduate
President	58.3	30	53	34	24	10
Vice-president	50.8	28.1	48	30.7	25.2	5.5
General manager.....	49	30.5	16.8	31.4	26.2	5.2
Sup't. motive power..	43.8	25.8	44	29.9	19.9	10
Mechanical engineer .	35	13.75	80	14.6	13.5	1.1
Master mechanic ...	47.4	22.7	20	24.1	15.2	9.4

spent by the non-college trained and subtracting, we obtain the figures shown in the right hand column.

The good operating man seldom finds it desirable to leave railway service to work in any other industry. When he does, it is to take a good position where the executive ability brings him greater reward. There have

been few instances where a good operating man has left railway service. The "ten-talent" man in the operating department is almost certain of recognition.

As shown in Table III, the engineering or maintenance of way department is another that has always seemed to have received proper recognition. Many railroad division engineers or chief engineers have succeeded in stepping over into the operating department and have thus proceeded on their way to the top. The list of railway presidents who started in railway service as rodmen or transit-men is quite a long one. This information is of interest to mechanical engineers whose technical education is similar in many respects to that of the civil engineer.

No less than 25 per cent of all railway operating expenses and from one-half to two-thirds of the expenditures for capital improvements come under the jurisdiction of this department. The January 2, 1926, issue of

Table V—Years required to reach certain positions in the mechanical department

	Longest time	Shortest time	Average
General S. M. P. or head of mechanical department	49	10	22.8
Assistant or division S. M. P.	36	7	18.8
Mechanical engineer	33	4	15.2
Assistant mechanical engineer	11	4	8
Engineer of tests	19	5	9.75
Engineer of motive power	24	7	18

the Railway Age reports that 35 per cent of the total appropriation for capital expenditures for the first nine months of 1925 went for equipment. This shows that the job of the mechanical department officer is one of importance and great responsibilities and requires men capable of exercising mature judgment.

This statement is undoubtedly emphasized by the figures shown in Table V, which shows the years required to reach certain positions in the mechanical department. One mechanical engineer worked for 49 years before becoming head of the mechanical department of his road. Another worked for 10 years. The average time required for all those of whom the sub-committee obtained complete data was 22.8 years.

Table VI, which shows the number of years that have been required to reach certain railroad executive positions, cannot be considered as indicative of the actual opportunities afforded members of the profession in reaching the positions shown.

Table VI—Years required for mechanical engineers to reach certain railroad executive positions via the mechanical department

	No. of officers	Longest time	Shortest time	Average
President	1	38	..	38
Vice-president	5	40	11	29.2
Chief purchasing officers ..	2	35	26	30.5

Table VII shows the maximum and average salaries paid for certain representative positions or equivalent in the mechanical department in 1921. This information was obtained from a report of hearings before the Committee on Interstate Commerce, United States Senate. Table VIII is shown for purposes of comparison with the salaries paid to engineering graduates in all industries. This information was obtained from a bulletin entitled "Study of Engineering Graduates and Former Students" published by the Society for the Promotion of Engineering Education. In addition to the information relative to salaries, given in Tables VII and VIII, charts on which are plotted curves showing sala-

ries paid by the railroads and salaries paid in other industries since graduation, have also been prepared.

Facts relative to the railway supply industry

A total of 517 manufacturing companies engaged in selling supplies to the railroads wholly or in part are

Table VII—Maximum, minimum and average salaries paid for certain representative positions or equivalent in mechanical department in 1921

	Maximum salary	Minimum salary	Average salary
Mechanical department heads	\$25,000	\$4,500	\$8,430
Assistant or division S. M. P.	10,200	4,000	6,660
Mechanical engineer	11,320	4,000	5,410
Assistant mechanical engineer	9,600	3,700	4,930
Engineer of tests	10,000	4,000	5,680
Engineer of motive power.....	8,000	4,000	5,940

listed in the Pocket List of Railroad Officials. These 517 supply companies employ approximately 7,000 men as executives and sales engineers, a large proportion of which, we have good reason to believe, are men of technical education. There are also 37 private car companies

Table VIII—Analysis of earnings of engineering graduates as of June 1, 1924*

Class	Years since graduation	No. reporting	Annual Earnings				Most frequent
			Limit of lowest (25%)	Medium	Limit of highest (25%)	Maximum	
1924	0	1,191	1,200	1,476	1,560	4,080	1,200
1923	1	1,218	1,560	1,800	1,980	5,100	1,800
1922	2	1,023	1,800	2,100	2,400	9,000	1,800
1919	5	309	2,400	2,860	3,500	25,000	3,000
1914	10	498	3,110	4,000	5,100	50,000	5,000
1909	15	430	3,600	5,000	3,000	49,500	6,000
1904	20	238	4,000	5,500	10,000	90,000	4,000
1894	30	116	4,500	7,500	15,000	100,000	6,000
Total		5,023					

*See "Study of Engineering Graduates," published by the Society for the Promotion of Engineering Education, page 287.

that own and operate over 1,000 cars that should also have need for a limited number of mechanical engineers.

Table IX showing the careers of officers holding certain representative positions contains only a few railway supply company officers when compared to Tables III and IV. In collecting data for this table only the careers of railway supply company officers promoted since December, 1919, were considered. An interesting item in this table is the large number of vice-presidents as compared to officers of lower rank. The reason for having 35 vice-presidents and only 12 and 11 general managers or chief engineers is because of the fact that the functions of the latter officers are quite often handled by men holding the title of vice-president. It is not an uncommon thing to have a "vice-president in charge of engineering" in a railway supply company or to see the title of "vice-president and general manager."

Table IX—Careers of officers holding certain representative positions in railway supply companies

	No.	No. who started on Ry.	No. who started with Ry. S. Co.	Common school	High school or equal	College graduates	Per cent college graduates
President	28	6	22	4	6	18	35
Vice-president	35	21	14	10	8	17	48.6
General manager	12	4	8	2	1	9	75
Chief engineer	11	4	7	1	1	9	81.8
Manager of sales.....	12	7	5	2	3	7	58.3
Railroad representative. 12		9	3	2	1	9	75

Tables IX and X are arranged for comparison with Tables III and IV. It is interesting to note the similarity in respect to time element between the careers of railroad presidents and the presidents of railway supply companies. There is also a large degree of similarity in this respect between the vice-presidents in both indus-

tries, but somewhat greater difference in figures appears in the careers of officers of lower rank.

Table XI is arranged for comparison with Table V. Higher officers are included in Table XI, however, owing to the fact that the duties and responsibilities of many railway supply company executives include problems of a

Table X—Average ages, time required to reach certain positions and time gained by college graduates in railway supply companies

	Average Age	Average time in Ry. and Ry. S. S.	Average time for Non-college man	Average time for college graduate	Time (yrs.) gained by college graduate
President	56.6	27.1	35.5	22	13.5
Vice-president	47.75	28.9	32.2	23.8	8.4
General Manager	44.7	29.2	32.4	26	6.4
Chief Engineer	46.25	33.2	41	30	11
Manager of Sales	46	21.75	27.25	18.9	8.35
Railroad Representative..	43	27.1	3.8	20.9	17.1

mechanical engineering nature. This statement, however, does not apply in all cases, for example the American or Baldwin Locomotive Works, or the American Car & Foundry. But, it can be said that a large share

Table XI—Years required for mechanical engineers to reach certain representative positions in a railway supply company

	Longest time	Shortest time	Average
President	45	15	26.8
Vice-President	39	11	25.2
General Manager	45	12	29
Chief Engineer	36	20	26.4
Assistant Engineer	22	15	19
Manager of Sales	40	12	21.2
Assistant or District Mgr. Sales.....	26	11	19.6
Railroad Representative	43	4	21.2

of the problems confronting the president of the average railway supply company are similar to those of the superintendent of motive power of a Class I railroad. He

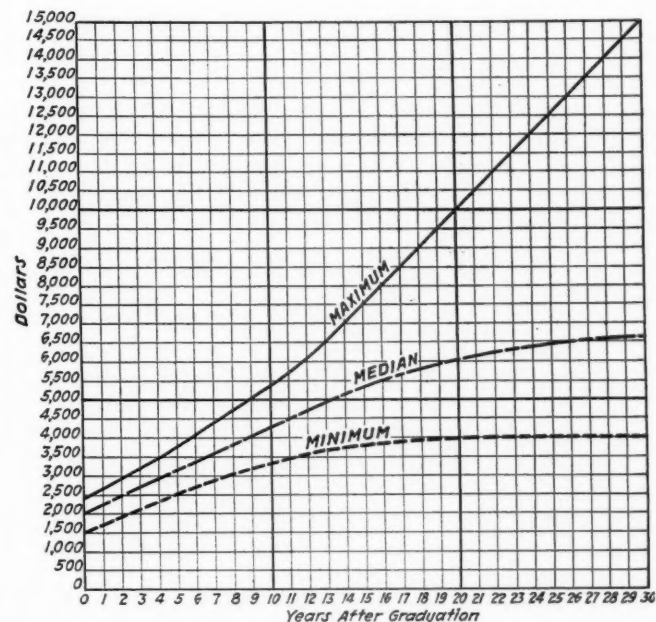
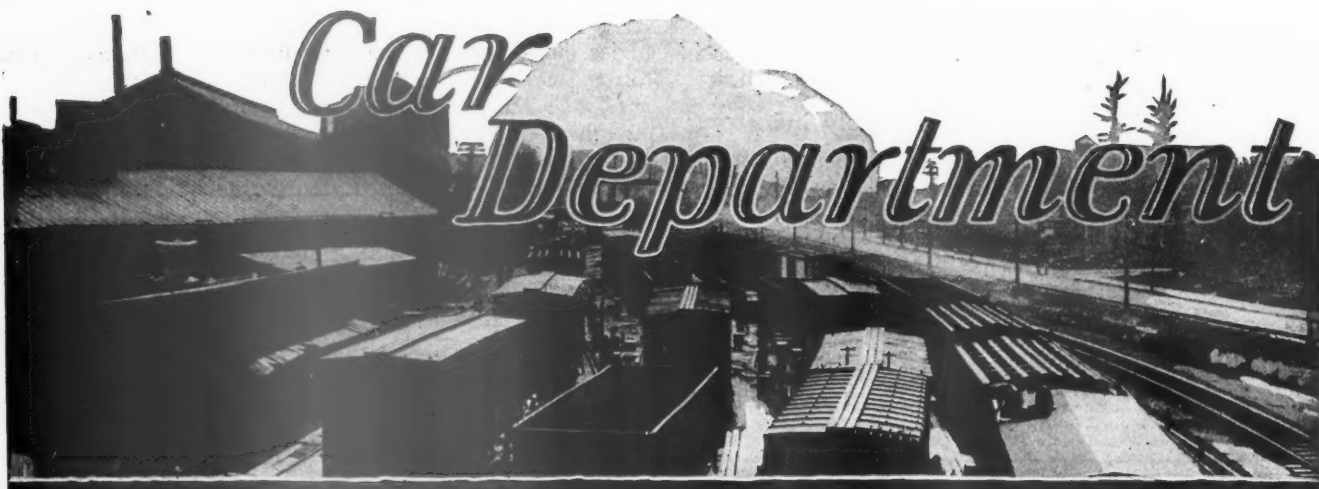


Chart showing the earnings of mechanical engineers employed by railroads up to and including the position of chief of motive power

should have sufficient technical knowledge to make intelligent decisions on engineering problems.

The report is signed by Marion B. Richardson, associate editor, *Railway Mechanical Engineer* (chairman); Professor A. J. Wood, The Pennsylvania State College, R. S. McConnell, chief engineer, Baldwin Locomotive Works.



Box car side frame design*

By R. M. Mochrie

Draftsman, Canadian Pacific, Montreal, Que.

THE wood superstructure car was in universal use until 1907, when the steel superstructure made its appearance. The wood superstructure was replaced by the steel superstructure, just as the wood underframe was replaced by the steel underframe. The steel underframe wood frame car was hardly satisfactory, because of the continual repairs required to keep it intact on a rigid underframe. The posts and braces became loose; the frame and roof moved in all directions under severe switching and overload conditions, so that it was almost impossible to keep the sheathing, lining and roof on a car for a reasonable period of time.

The steel superstructure, while it has many distinct advantages over the wood frame has not been an unqualified success. The posts, braces and connections break so frequently in the steel trusses of the single sheathed cars, that there is still much scope for improvements in their type.

At first sight the design of the side truss of a box car would seem a comparatively simple matter, and the structural engineer would probably smile at the idea of any calculations being required at all. This would be true, if the steel framing were utilized with slight modifications for a small truss girder bridge; then there would not be any failures in the stress members, because the factors governing them, could be accurately determined. It is when the steel work is placed on the trucks that the difficulties arise, and the frame members of the structure fail.

Indefinite forces

Oscillation, end shock, longitudinal force and centrifugal force produce stresses and strains in the whole structure which cannot be accurately determined.

Oscillation stresses in an overloaded car with the maximum side bearing clearances cannot be satisfactorily determined. While the effect of this force would be largely taken by the underframe members, it undoubtedly tends to produce unevenness at the supports for the truss members by the bulging of the side plates and twisting of side sills.

The end shock produced by buffing may vary from

100,000 lb. to 500,000 lb. or more. Some cars may never be subjected to the former load, while others may have to stand a load in excess of the latter figures. The

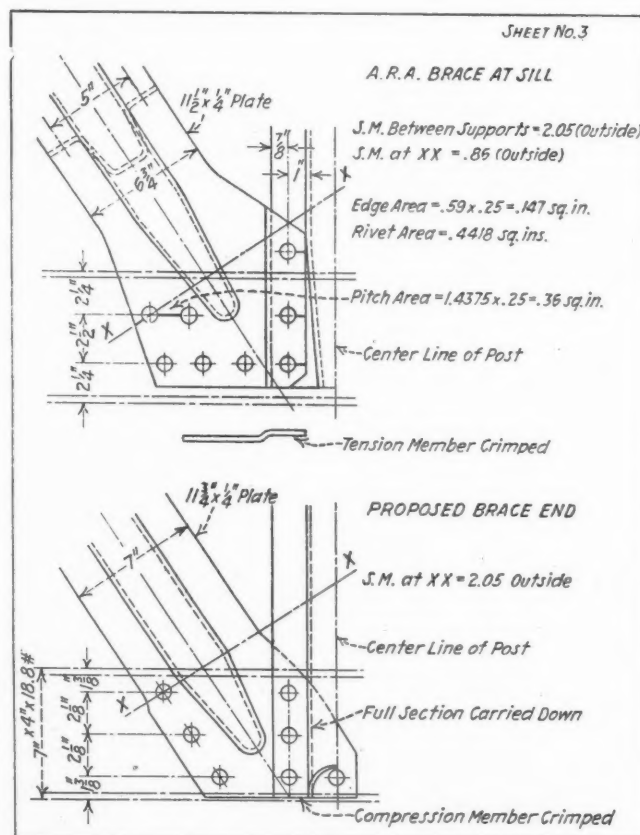


Fig. 1

A.R.A. specifies an end load of 250,000 lb. This shock load is taken directly by the center sills, but a portion of it is transferred to the side frames and they must be prepared to absorb it.

The longitudinal shifting of lading is another force

*An abstract of a paper presented before the September 14, 1926, meeting of the Canadian Railway Club at Montreal.

which varies greatly with conditions. It may cause the end posts of some cars to bulge 6 in. yet in other cars of the same class, there may be very little bulging. Considering the force necessary to bend the end posts, it can be estimated that the reactions at the end plates which are transferred to the ends of the side plates are approximately 15,000 lb. at each end.

Centrifugal force may be calculated, but it is doubtful if the results would mean anything under actual conditions. Speed on curves is taken care of by the super-elevation of the track so that the centrifugal force against

post and satisfactory riveted conditions provided. The latest A.R.A. designs still show defects in this respect. Sheet No. 3, Fig. 1, shows the section modulus at XX. for the A.R.A. brace reduced to .86 outside, which brings the stress up at this point to over 300,000 lb. per sq. in. The proposed brace end shows the section carried down far enough to keep the stress at 16,900 lb. per sq. in. as shown on Sheet No. 1, Fig. 2.

Second—The rivets in these connections are usually poor on account of the unfavorable conditions existing at the juncture of the posts and braces; where the one is crimped over the other, and where the pitch of the rivets is sometimes no more than 2 in. The edge distance and pitch area of the plates are seldom equal to the value of the rivets. These defects are common in pressed-member trusses and still exist in the latest A.R.A. designs (see Sheet No. 3, Fig. 1). The edge area of the brace is only one-third the value of the rivet, and the pitch area (2 in. pitch) is only two-thirds the value of the rivet. It may be argued that these areas have been taken horizontally, which does not represent the line of greatest force. The horizontal force is large enough, however, to justify larger edge distances on the plates. The crimped end in the tension member is not a good feature, as it tends to straighten out and thereby reduce

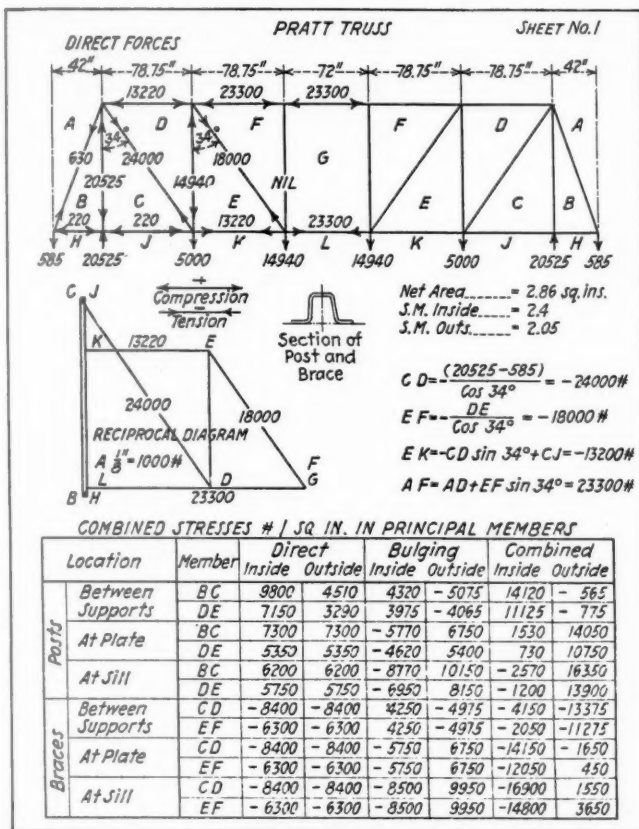


Fig. 2

the sides on good tracks is practically nil. This force most probably is at a maximum when a slow moving freight train stops and starts on a sharp curve of maximum super-elevation. A most severe condition exists on entering a curve, especially where the tracks are poor. The leading truck shoots the outside corner of the car upwards, while the rear truck is still on the level. This produces a diagonal twisting strain over the entire structure.

Causes of broken members

The causes of broken posts, braces and connections are first, reduction of effective section, second, poor rivets and riveting conditions, third, unequal settlement of supports, fourth, eccentricity, fifth, cutting down of material.

First—The effective section in the members at the supports is reduced so much that it cannot resist the bending moments at the top and bottom of the frames. An examination of broken parts will show that the section modulus in pressed sections has been reduced over 50 per cent of the value of that part between the supports. This reduction was made to facilitate riveting, but frequently it need not have been made at all, as the full section could have been carried the full length of the

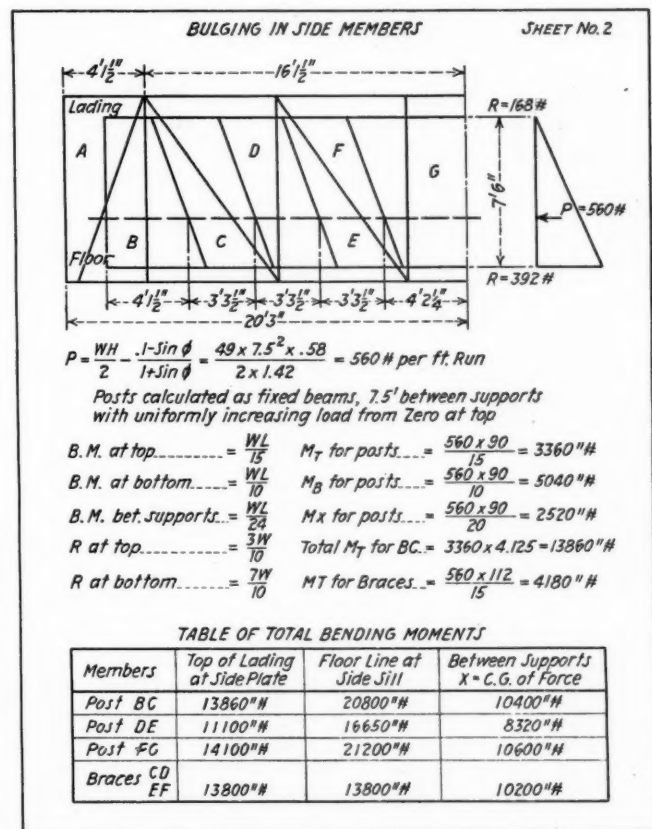


Fig. 3

the efficiency of the rivets. The proposed brace end shows the post compression member (which is not so highly stressed as the brace) crimped instead, and the other defects are practically eliminated.

Third—The bulging of the side plates or the twisting of the side sills will cause unequal settlement at the supports for the posts and braces. It is not uncommon to find them 2 in. to 3 in. off square laterally. The side members are considered by the A.R.A. as fixed, although they are at the best only half-fixed. In either case, how-

ever, it is essential for this type of beam, that the supports be absolutely equal. Structural engineers avoid fixed beams, because in fixing the ends securely, the tangents at each end of the beam must be absolutely horizontal, and any deviation from this will alter the stresses, and any difference of level at the two ends due to unequal settlement will cause considerable stresses in the beams.

Fourth—Eccentricity exists in every type of side truss and varies from 2 in. to 9 in. In zee bar frames, where it is large, the failure of the connections is mostly due to eccentricity. It is not easy to eliminate eccentricity as suitable riveting must be provided at the supports. The most suitable section for minimizing the eccentricity is the pressed section—which is probably the most suitable from every point of view. The A.R.A. single sheathed box car designs show no eccentricity at the side plates, and the eccentricity is cut down to a minimum at the side sills by the use of this section.

Eccentricity can be determined by using the following formula:

$$\text{Safe eccentric load on the member} = \frac{\text{Safe control load}}{(1 + xdc) / r^2}$$

Fifth—The strength of the frame members is often sacrificed to save weight. For instance, in the A.R.A. bolster post the width of the post is $6\frac{3}{4}$ in. It is secured by two $\frac{3}{4}$ -in. rivets at 5-in. centers to the side sills by means of a cleat. This leaves merely $\frac{7}{8}$ in. from the center of the rivet to the edge of the plate. The strain of punching the holes, especially so near the edge, will damage the material to such an extent that what remains is probably not worth 20 per cent the value of the rivets. The cumulative effect of the known and unknown forces acting at any joint in the frame is apt to open the material on the outside edge, and this will gradually tear across with repeated applications of these forces.

Design of Pratt truss

Sheets No. 1 and No. 2, Figs. 2 and 3, show the stresses worked out in the various members of a Pratt truss for a 50-ton single sheathed box car, 32 ft. 3 in. centers of trucks. Sheet No. 2 gives the bending moments caused by the bulging load. This load is calculated by the Rankine theory of pressure on retaining walls—the angle of repose for wheat is taken at 25 deg. The A.R.A. use the "influence line" and "formula" methods to calculate the bending moments, but either of these methods is unnecessarily laborious. They assume the points of supports at the neutral axes of the side plate and side sill, but in reality, the points of supports are at the juncture of the members or along the lines of the innermost connecting rivets. A table of total bending moments is compiled by the use of comparatively simple data, which give the bending moments at the floor line and load line, which lines coincide with the points of supports, top and bottom, at the juncture of the members.

Sheet No. 1 shows the direct forces obtained by the reciprocal figure and checked by calculation. A table of direct, bulging and combined stresses is given for the principal members. The top and bottom chords are subjected only to direct stress, while on the other hand the door posts are subjected only to bulging stress. There is a little secondary bending in the bottom chords in and near the doorway, but it is negligible.

The direct stress in post B.C. at the sill appears small; this is due to a larger area of plate being assumed at this point.

The stress in the compression posts between the supports has been calculated by the Rankine formula:

$$S = \frac{P}{A} \times \frac{1}{1 + \frac{1}{25000} \frac{(l)^2}{r^2}}$$

Load Distribution

Weight on rails		
Weight of trucks		
Weight of structure		
Weight of ends	2,200 lb.	
Load on center sills	90,100 lb.	92,300 lb.
Load on side tresses		61,700 lb.
Load on one truss		30,850 lb.
Load per linear inch		63.5 lb.
Force A. H.		
Uniform load	63.5×24	1,525 lb.
From ends	$2,200 \div 4$	550 lb.
Center sill reaction		2,075 lb.
Force J. K.		585 lb.
Uniform load	63.5×78.75	5,000 lb.
Force K. L.		
Uniform load	63.5×75.38	4,790 lb.
Transferred from crossbearer		10,150 lb.
Reaction H. J.	$= 585 + 5000 + 14940$	14,940 lb.
		20,525 lb.

Decisions of the Arbitration Committee

(The Arbitration Committee of the A.R.A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Air brake cleaning marks claimed incorrectly reported

The Western Maryland rendered a bill against the Charleston & Western Carolina in which was included a charge for cleaning air brakes on C. & W. C. car 1206. The C. & W. C. took exception to the charge in accordance with Rule 91 because of the fact that the Western Maryland showed the old air brake cleaning date to be "Aug.—C. & W. C.—8-7-23" asking that the correct car number, initial or the date of old cleaning be shown. The car owner contended that the old cleaning date as reported could not have been correct because of the fact that the car was not on the line indicated on the date reported but was on the C. B. & Q., which road did not clean the air brakes on this car while it was on its line. The Western Maryland in its statement was positive of the fact that the old cleaning marks as reported were as they existed on the car at the time it was received and that if the marks were not the correct ones then the stenciling shown by the Western Maryland would indicate that the road which made the prior cleaning of air brakes failed to stencil the car properly or to remove the old marks. The W. M. contended that it was in no way responsible for incorrect stenciling by some other road.

The Arbitration Committee in rendering its decision did not sustain the contention of the Charleston & Western Carolina.—Case No. 1433—Charleston & Western Carolina vs. Western Maryland.

Repairs not made in accordance with car owner's instructions

On May 29, 1924, the New York Central reported C. & W. C. car No. 1540 to the owners for disposition under Rule 120. After some correspondence because the New York Central had reported the same car August 31, 1923, for disposition under Rule 120 and had been

authorized to make all necessary repairs, which were reported as having been completed October 8, 1923, the N. Y. C. was authorized on July 8, 1924, to make the repairs called for by the joint inspection. The N. Y. C. was instructed that "When repairs have been made strictly in conformity with the above specifications and in no other way, if this company is responsible for the repairs, you may render bill against the C. & W. C. for the cost of such repairs in accordance with the A. R. A. Rules, attaching carbon of this letter to your bill as authority." The N. Y. C. rendered a bill which the C. & W. C. declined to pay, claiming that the repairs had not been made in accordance with its instructions and specifications. Among other items the C. & W. C. claimed that the car was repaired by using spliced center sills instead of full-length center sills as instructed. The N. Y. C. declined to cancel the bill, taking the position that the car owner should pay the bill and handle in accordance with Rules 12 and 13 for relief.

The Arbitration Committee in rendering its decision said that "The bill of the New York Central should be paid irrespective of the question of responsibility for improper repairs. The New York Central should issue its defect card for the longitudinal sills in view of definite instructions issued by the car owner under Rule 120. The principle of Decision 1230 applies. If there are other improper repairs joint evidence will be necessary."—*Case No. 1434—Charleston & Western Carolina vs. New York Central.*

Responsibility for old defects existing on forwarded cars

On July 25, 1923, Transcontinental Oil Company's car TROX No. 1527 was delivered to the Mid-Continent Tank Car Company's plant at Coffeyville, Kansas, by the Missouri Pacific. The car was billed to the tank car company by the owner for repainting. It was sent to Coffeyville without any payment of revenue for the trip, but, under the usual method of free movement of empty tank cars, with the understanding that all the empty mileage would be equalized with load mileage. On the arrival of the car at Coffeyville the tank car company made a claim against the Missouri Pacific for defect cards to cover a number of defects, the existence of which were acknowledged by the Missouri Pacific, as the car was jointly inspected by a railroad and Tank Car Company representative. At the request of the Missouri Pacific the tank car company handled the matter with the car owner in an effort to locate the company actually damaging the car and the railroad handled the matter with the Kansas City Interchange Bureau, for the same purpose, but both failed. The tank car company maintained that, from the time the car was delivered to them, the Missouri Pacific was responsible under Interpretation No. 1 of A. R. A. Rule 4, and should issue its defect card as the delivering line in the case. The Missouri Pacific contended that it was not responsible and quoted Interpretation No. 2 of A. R. A. Rule 4, and that since the car was moved from Cleveland, Ohio, consigned by the Phoenix Oil Company to the Mid-Continent Company at Coffeyville, Kan., routed L. E. & W. to Bloomington, C. & A. to Kansas City, Frisco to Ft. Scott, and Missouri Pacific to Coffeyville, the defects could have occurred while the car was on any of these roads.

The Arbitration Committee stated that "the contention of the Missouri Pacific is sustained. In view of the car having been billed from Cleveland, Ohio, to the Mid-Continent Tank Car Company's plant at Coffeyville, Kan., for repairs, Interpretation No. 2 of Rule 4 applies.

"It is not intended that determination of responsibility

of intermediate road for damage to cars forwarded by the owner to a contract shop for repairs is to be made under Rule 4 unless there is conclusive evidence of the car having been damaged on that road. Responsibility under Rule 4 applies to cars moving in regular interchange service. In the cases above referred to, the responsibility for delivering line defects, if any, should be settled by the consignor or other representatives at the time of forwarding the car. It is not the practice generally to take a record of old defects on cars passing in interchange.—*Case No. 1425, Missouri Pacific vs. Mid-Continent Tank Car Company.*

Car not subjected to unfair handling under Rule 32

Central Railroad of New Jersey hopper car 51793, stenciled capacity 80,000 lb. of steel construction and built in July, 1906, was damaged while being handled in a New York Central train and disposition was requested under Rule 120. The car was damaged when the train parted because of knuckles slipping and because of worn knuckle pin holes in the coupler and worn knuckle locks. The rear end of the train, after parting, followed up and struck the head end with sufficient force to cause considerable damage to the car. The owner contended that the damage resulted from faulty inspection and as such the responsibility should rest with the handling line under Rule 32. Investigation disclosed that the train parted between the forty-first and forty-second cars from the head end of the train, the train consisting of 47 cars. The car in question was the fortieth car from the head end.

The Arbitration Committee in rendering its decision stated that "the car was not subjected to unfair handling within the intent of Rule 32. The car owner is responsible."—*Case No. 1431, Central Railroad of New Jersey vs. New York Central.*

Useful kinks from the D. & R. G. W. car shops

By J. C. Coyle

Denver & Rio Grande Western, Denver, Colo.

RAILWAY shop work, because of the great variety of conditions encountered, brings forth many devices developed by the mechanics themselves to simplify their tasks or speed up production. The accompanying illustrations show several shop kinks that have proved



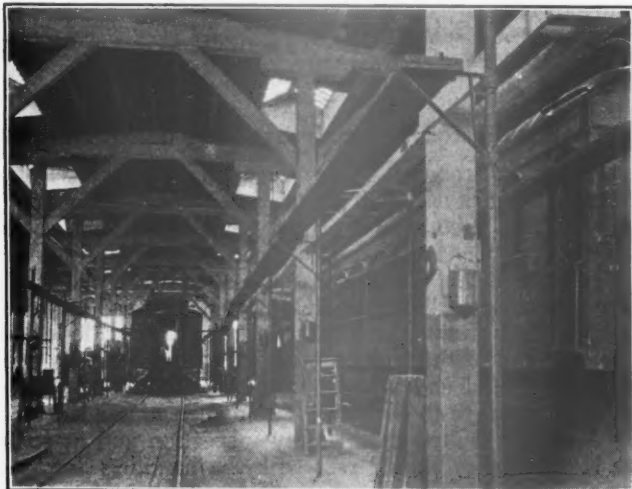
Three simple devices which facilitate work in the tin shop

useful in the coach shops of the Denver & Rio Grande Western at Denver, Colo.

Adjustable scaffolds—The main columns, which support the scaffolding, are of heavy three-inch pipe, with

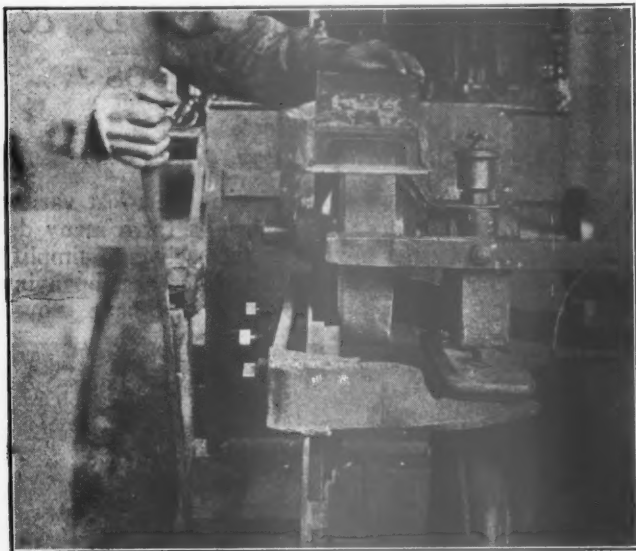
holes 12 in. apart, into which are fitted cotter keys on which the collars of the scaffold frame rest. These collars are made of short sections of larger pipe, to which triangular frames of $\frac{1}{2}$ -in. by 2-in. steel are welded. With this arrangement it was found that the scaffold boards could be adjusted to any desired height.

Grinding forming tools—In the wheel shop a great deal of trouble was experienced in keeping forming tools



A simple coach shop scaffold using pipe as the supporting framework

sharp for surfacing wheels until the floating pressure plate shown in the illustration was devised, for grinding the tools upon the side of the emery wheel. Formerly the tools had to be sent to the machine shop for grinding by a machinist, and with a few grindings they were thrown away as useless. Now they are ground in the wheel shop, by an apprentice, and, with an even pressure



Method of using the device for grinding wheel lathe forming tools

which assures the survival of 25 or 30 sharpenings.

A plate $\frac{3}{4}$ in. by 6 in., and long enough to pass above the side of the emery wheel, was attached to the bottom of the stand by a $\frac{3}{4}$ in. bolt, encased in a strong spiral spring. In the center of this plate, on the outside, a handle was riveted, of sufficient length to allow the operator to stand erect. Resting upon this handle, and partly supported by a narrow strap encircling this plate,

a second plate of metal $\frac{1}{4}$ in. thick and 12 in. wide by 18 in. in length forms a floating pressure surface, as the tool is moved back and forth along the side of the emery wheel.

A strap 4 in. by $\frac{3}{4}$ in., bent to encircle the pressure plate, and twisted so as to bolt onto the stand proper, contains three set screws, which aid in adjusting the pressure, as the grinding proceeds. A narrow Z-shaped strip of metal, welded to the inner surface of the pressure plate, serves to support the forming tool.

Tin shop tools—The rivet holder is made in any size desired, of heavy tin, on a framework of stiff wire. It has a hinged lid on top, to admit the rivets. Labeled partitions separate the different sizes of rivets. The bottom being sloped toward the trough in the front, the rivets roll down and are easily accessible in the trough.

The clamps for holding sheets of metal firmly to the work bench are made of eight-in. sections of spring steel 1 in. wide by $\frac{1}{4}$ in. thick, bent to the shape shown by the middle clamp, which is removed from the work. These clamps are quickly applied, as quickly removed, and answer the same purpose that others more complicated are used for.

The broad jawed bending pliers, used in small bending operations, are made by welding two three-in. sections of $\frac{1}{4}$ -in. steel, ground on the outer side to a thin edge, onto to a pair of rivet heater's tongs.

Safety step ladders for the coach shop

By Charles W. Geiger

THE step ladders shown in the illustration are designed to facilitate getting in and out of a car equipped with end doors, such as passenger coaches or express cars. Ordinarily a workman is required to set his tools or material up in the car before getting in and



Step ladders with hand rails facilitate entering cars in the coach shop

then climb in afterwards. These steps are provided with handrails and a man can walk erect up the steps with tools or material in one hand, using the other hand to hold on to the hand rail. Considerable time is saved by the use of these steps, especially when a workman is required to make frequent trips.

Economy in wheel service

Abstract of a paper presented at the November meeting of
the Car Foremen's Association of Chicago

By *G. T. Ripley*

Chief mechanical engineer, Atchison, Topeka & Santa Fe, Chicago

APPROXIMATELY twenty-four million cast iron wheels and three million steel wheels are in service on American railroads and approximately four million wheels are applied per year for repairs. There is no way to determine the exact figures but those given are fairly representative. The net cost of a cast iron wheel, using A. R. A. prices, averages \$10.45. The labor cost involved in removing the wheels and mounting new wheels, under A. R. A. prices, is approximately \$1.85 per wheel. Thus the cost for cast iron wheel work per year may be roughly estimated at fifty million dollars, which is a huge figure and one which warrants the attention and serious study of railroad officers in an effort to effect economies.

I wish it clearly understood that what I may say is strictly a matter of my personal opinion and that I am not tonight representing the railroad company by which I am employed or any committee of the American Railway Association with which I may happen to be affiliated. Also, I do not mean, in any way, to present data favoring one type of wheel against any other type, for I fully realize that local conditions are the governing factor as to the proper type of wheel for any particular service, but inasmuch as the majority of wheels in service are cast iron, I am going to devote most of my time this evening to a discussion of this particular product.

The average railroad car inspector through long experience is highly qualified to pass on defects in wheels. However, certain unfortunate conditions have arisen which have tended to take away from the inspector the exercise of proper judgment. There has been too great a tendency to condemn the inspector, write him up, give him demerits and even discharge him for passing wheels which are condemned by another inspector farther down the line. In many instances the second inspector may be the one who has made the mistake, but there has been no machinery by which this could be checked up and the blame put upon the proper party. The inspector is almost never praised or given credit for letting wheels run when they are perfectly safe to run and thus saving his employer money.

What has been the result and what would you or I do if we were in the inspector's position under similar conditions? We would do just as many of them have done—become more and more rigid in our inspection and condemn any wheel which there was the least chance of the next inspector down the line condemning. Furthermore, we would be looking for a chance to get something on the next inspector. As a result of this the rigidity in inspection has increased and increased until many wheels are condemned which are perfectly safe for service, with a resultant loss of large amounts of money.

What we need is a change in the system, whereby an inspector will be condemned for passing a wheel which is truly dangerous but will also be condemned for taking out wheels which are safe to run and will be given credit for catching dangerous wheels. In cases of difference in opinion between inspectors, some competent third

party should pass on the matter and make a fair decision. If this is done inspectors will feel free to use proper judgment in their work and I have found in my dealing with them that this is what they are anxious to do and as I said before, I have faith in their judgment. If the master mechanics, general foreman, etc., will take a little more interest in the matter they can help the inspectors in forming judgment on questionable defects.

There are two general classes of defects. The first class are those which are liable to cause accidents and we cannot be too rigid in our inspection for these particular defects. I would be the last person to recommend any let down in their inspection. The defects to which I refer are cracked plate, seams and loose wheels. The other group of defects are, in extreme cases, liable to cause trouble, but generally speaking they are not in the same group as those which I have listed above. I will now take the individual defects and discuss them separately.

Cracked plate wheels

The biggest advance toward the prevention of cracked plates is in a new design of wheel now being developed, known as the single plate wheel. In thermal tests, this wheel stands a great deal more than the standard double plate type. The metal is concentrated in the plate, giving a thicker plate instead of being scattered out in brackets, double plate, etc. It is my personal opinion that this wheel will ultimately supersede all of the present designs, though further service tests are necessary to prove the desirability of this design.

We should give the wheels more protection in service to help prevent cracked plates. The operation of a long freight train down mountainous grades can be handled in such a way as to protect the wheels by getting the heat into them gradually. If the braking at the start is less severe and if cooling stations are established less cracked plates will result. The improvement of the triple valve to prevent kickers will give the engineman confidence in applying the brakes at low speeds, which will also protect the wheels. This improvement can be secured by the use of heavier triple valve release springs and I hope the time will come when all of the railroads will go to this small expense not only for the protection of the wheels but for the protection of the equipment and the trainmen.

The braking system needs further study. Refrigerator cars with their high light weight have a very severe braking service, since the standard braking power is based on the light weight of the car rather than loaded weight, and incidentally it is the refrigerator car that gives the most trouble with cracked plate wheels. This subject is being given careful study at the present time and I believe ways will be found to effect a needed improvement.

We have found that inspectors frequently take out wheels for cracked plates when in reality the plates are not cracked; there is simply a line on the surface which

looks something like a crack. However, this is such a dangerous defect that I do not believe we should tell an inspector to take any chances. If inspection at the wheel shop shows it is not cracked it can be put back in service, but even here care must be used. Serious as the cracked plate problem is, I believe that the introduction of the single plate wheel and certain improvements in braking practice are practically going to solve it.

Seams

It is now very generally admitted by wheel manufacturers that a seam is a foundry defect resulting from improper pouring of the metal or in the quality of the metal. It is one of the most difficult defects to locate, inasmuch as the seam is ordinarily covered over with good surface metal and the wheel will at times break before the seam can be seen. It is common experience to find that the majority of wheels which break because of seams do so fairly early in the life of the wheel, as indicated by the thickness of the flange. Inspectors should condemn a wheel which shows the slightest indication of seams in the throat, for there is no telling what the extent of the seam may be. Seams farther out in the tread are less common and less dangerous in service.

The best remedy for this trouble is better foundry practice, though the re-enforced flange which is now in use on a good many railroads is being recommended by some of the manufacturers and may be helpful in preventing breakage of flanges, even though there is a seam present.

Loose wheels

The loose wheel is an aggravating defect. We are constantly having wheels condemned by inspectors as loose, which when taken to the wheel press are found to be tight. The inspectors, seeing an indication of oil working out of the fit, very properly condemn a wheel as loose and we cannot ask them to change this practice, but what we can do is to mount the wheels in such a way that no such showing will appear unless the wheels are actually loose.

The trouble is that many wheel shops are using the wrong material for coating the wheel seat of the axle. They are using materials which are thinned down with light oils, which are unsatisfactory. Some roads are having success with the use of brown mineral paint, but the best material to use is white lead and linseed oil of a proper consistency.

Chipped rim

Rule 78 of the Interchange Rules merely specifies the distance from the throat of the flange to which this defect may extend. Unfortunately this does not properly cover the situation. There are some cases where there is a small surface flaked out of the tread, which falls within the gage limit. Such a wheel is absolutely safe to operate, but technically the inspector is right in condemning it.

There are entirely too many wheels condemned for this defect. We have plenty of width of tread in our present design wheels to run with this slight defect at the outside of the tread. Unfortunately, it is hard to write a rule which will cover every case and particularly cases where the breakage slopes inwardly under the rim. Our inspectors can, however, be taught to use judgment in gaging this defect and it is hoped that some time the Rule can be changed in such a way as to better cover the proper gaging.

The greatest advance toward the prevention of this defect has been the development of the so-called lip

chilled wheel. In this wheel the chill runs to the outside of the tread instead of having a narrow sand rim as was the past standard. It was found that the grain at the juncture of the chilled section and the sand rim was of such a nature as to invite cleavage. Certain modern types of frogs which include guard rails give the outside of the rim very hard service and we need the best conditions at this point to meet this service. I believe that the lip chilled wheel will reduce the chipped rim defect at least 50 per cent.

Worn through chill

Worn through chill is strictly a judgment defect, but we have found that many wheels are taken out for worn through chill which actually have a large amount of chilled metal left in them. In the inspection of new wheels, a check of the test wheels is always made to determine the chill and very few wheels with chills less than $\frac{5}{8}$ -in. in the center of the tread are found. Therefore, with our limits of wear there should be very few worn through chill wheels.

There is an opinion among some inspectors that the worn through chill wheel is a dangerous wheel at all times. This opinion is hardly true and it is our opinion that a worn through chill wheel should be allowed to run until there is some indication of flatness at this point. Mere judgment passed on the feel of the metal or on the mottled appearance is not sufficient to establish definitely worn through chill. If a hollowness starts to develop at the point, the wheel should undoubtedly be taken out, as the chill is worn through.

Thin flange

The measurement of thin flange is a simple matter with the gage, and little discussion of this defect is necessary. Generally speaking, very few flanges wear to the condemning limit, for in most cases they wear to $\frac{7}{8}$ -in. vertical flange before they will wear to the thin limit. The re-enforced flange will, unless the condemning gages are changed, make this statement even more true.

Vertical flange

The vertical flange is the most common condemning defect in cast iron wheels. There is considerable question as to the correctness of the $\frac{7}{8}$ -in. limit which now covers the cast iron wheels for cars of 80,000 lb. capacity and over. The main purpose of this gaging is to prevent the splitting of frogs. There is no reason why the cast iron wheel will split a frog any more than a steel wheel which carries a 1-in. limit. Therefore, it is hard to understand why we should have a $\frac{7}{8}$ -in. limit. The strength of the flange is supposedly taken care of by the thin flange defect rule. There is a good deal of misunderstanding among the inspectors as to the gaging of vertical flanges. Some of them have an idea that if the flat surface on a flange is $\frac{7}{8}$ in. high, it is condemnable as vertical. This is not the way the rule reads or is intended. In order to be condemnable the bottom of the notch on the gage must touch the flange of the wheel. Furthermore, when the standard A. R. A. gage is used to measure $\frac{7}{8}$ -in. vertical on a wheel where the tread is worn the gage is cocked and an incorrect reading results. To overcome this, some roads have cut another notch at the $\frac{7}{8}$ -in. limit on the longer side of the gage. The gage is then applied on its narrow edge and the effect of the hollow wear in the tread is eliminated. This practice is apparently justifiable under the rules as written.

The shelled wheel is apparently not as common a defect as it formerly was. I believe this is due to improve-

ments in foundry practice. Its measurement is a simple matter and very few mistakes are made in this gaging. Most of the roads consider this a foundry defect and hold the manufacturer responsible, though it is admitted that sliding on the rail may contribute to its development. An important feature in this connection is that inspectors call certain defects shell-outs when they are not shell-outs. A true shell-out has the appearance of an oyster shell with a high center. A wheel which has a comby condition from brake burn is very frequently called a shell-out, but this is a mistake and inspectors should be instructed to properly designate the defect. There is practically no danger from this defect, but it is harmful to both track and equipment.

Brake burn

In mountainous territories more comparatively new wheels are taken out for this defect than for any other and inasmuch as it is strictly a judgment defect careful check of the inspectors' judgment should be made. Brake burn results from one of two causes, either the heat generated by the brake shoe or the heat generated by skidding on the rail. The nature of chilled iron is such that it cannot expand readily, and therefore, cracks or checks develop. There is in the minds of many inspectors a feeling that these checks will develop into cracked plate wheels. The best records available, however, indicate that wheels crack from the inside outward and not from the outside in.

Generally speaking, the brake burn wheel can be allowed to remain in service until it becomes comby and can be condemned under the new Rule 75. When this condition develops the wheel is hard on the track and on the equipment. If the checks or cracks are in the flange, the wheels should be condemned, for this may result in pieces of flange breaking out and as a general thing it is good practice to condemn wheels where checks run into the throat of the flange, as there is a chance of their developing into the flange before they are caught.

More can be saved through the proper discriminating application of this defect than any other defect. There are undoubtedly many wheels thrown away for this defect, which would render years of service. When these brake burn wheels are given a thermal test, it is surprising to find what a good test they will stand, indicating their strength and resistance to breakage. It is hoped that this rule can some day be altered so that it will be a measurable defect instead of a judgment defect.

Slid flat wheels

The slid flat wheel is the most common defect in mountainous territories. Their number has been greatly reduced by the education of the enginemen in the handling of their brakes, but we will always have large numbers of such wheels. There is a way to save them, however, and that is by grinding. We have advocated this practice for many years. We have two grinding machines operating on our railroad and they pay for themselves every six months, conservatively speaking. We know this work can be done at a cost of a little over a dollar a pair and why it is not gone into by more railroads than have gone into it, I do not understand. We have found the ground wheel truly round and excellent for service.

We must, of course, use judgment in selecting the wheels for grinding, as there is no economy in grinding wheels which have badly worn flanges, brake burns in the tread or are low in chill. The only trouble with which we are confronted is the hauling of wheels long distances to the points where the machines are located. We naturally locate the machines

near heavy grades where the maximum number of wheels are slid flat. It has been suggested that the way to meet this situation is to mount a machine on a car and thus make a traveling grinding shop. A portable machine has been developed, but it only grinds a short distance to either side of the slid flat. Some railroads feel that this is the proper practice, but so far the American Railway Association has not seen fit to endorse the practice, since it appears that this practice will result in making the wheels more out of round and every effort is being made to get the wheels more truly round.

Whatever the practice may be, the fact remains that large sums of money can be saved through the practice of grinding slid flat wheels. I am inclined to believe that it would pay us to grind all new wheels, in order to remove the eccentricities due to casting or to improper boring. It is an interesting fact to note that trainmen are anxious to have ground wheels under their cabooses, for they have found that their cars ride much better with these wheels.

Remount gage

The remount gages shown in the Rules of Interchange have not been given the use which they should have. Out of fairness to car owners, no wheels should be applied and billed as second hand, which will not pass these gages. It is realized that many wheels that would be condemned by this gage, are worth remounting and using, but they should not be used in a foreign car as the billing prices are based strictly on their use. The American Railway Association is making every effort to bring the importance of this matter to the railroads, and you gentlemen can help by insisting on the use of the gages. Their design is based as nearly as possible on the half way point on the wear of the wheel. The change in the gages made a year ago made them less restrictive and you should be careful in your shops to see that the right gage as now specified in the Rules, is in service.

Mounting gage

The standard gage for the mounting of cast iron wheels is a subject about which there has been a great deal of controversy. There are now several million re-enforced flange wheels in service. On these wheels the standard mounting gage cannot be properly used. Furthermore, this gage cannot be used when two maximum flange wheels are mounted on the same axle. Difficulty is being found by wheel shop inspectors when they try to apply the standard mounting gage to these re-enforced wheels.

Something will have to be done to straighten out the situation. The suggestion has been made that the gage be opened up at each end on both the flange and throat side $3/64$ in. This will still maintain the basic measurement from the throat to the back of the flange of 4 ft. $6-29/64$ in. The only real difference will be in re-enforced flange wheels, in which case the throats of the flanges will be closer to the rail. This, however, has been passed on by the committee of the American Railway Engineering Association and approved. In fact there is an opinion among many track men that this wider spread of the wheels will lessen both rail and flange wear.

If the gage is changed in this way it could be used on both the standard flange wheels and on re-enforced flange wheels. Its applicability to steel wheels would be somewhat of a question, but in reality the only proper way to mount steel wheels is with the back to back measurement, as has been recommended by the A. R. A. This question of the mounting gage is a live one and some action should be taken in the near future.

Seventy-ton ore cars for C. & N. W.

No center sills between bolsters—Intermediate sills at sides of hopper 5 ft. 3½ in. apart

THE Chicago & Northwestern handles a considerable tonnage of iron ore from the upper Michigan fields to lake docks. On account of the high unit weight of this ore, steel hopper cars of special design with a very short wheel base have been used for a number of years. They have been for the most part of 100,000-lb., 660-cu. ft. capacity. The cars of a new series of 150 now being built by the Pullman Car & Manufacturing Company have a weight capacity of 140,000 lb. and a cubic capacity of 975 cu. ft.

These cars are self-clearing hoppers arranged for center dumping into ore dock pockets and with a clear open-

the sloping ends of the hopper by 3-in. angles, which are carried up the slope to a junction with the two center end posts, thus forming a double triangular truss at each end of the car.

The deck plate also extends beyond the bolster between the intermediate sills and this portion of the plate is connected to the intermediate sills by means of riveted angles. This plate also forms a convenient platform for mounting the air brake equipment.

The bolsters are pressed diaphragm members riveted to the center sills, side sills and the deck plate. Intermediate sills of 12-in., 30-lb. channels, spaced 5 ft. 3½ in. back to



C. & N. W. 70-ton ore car—Built by the Pullman Car & Manufacturing Company

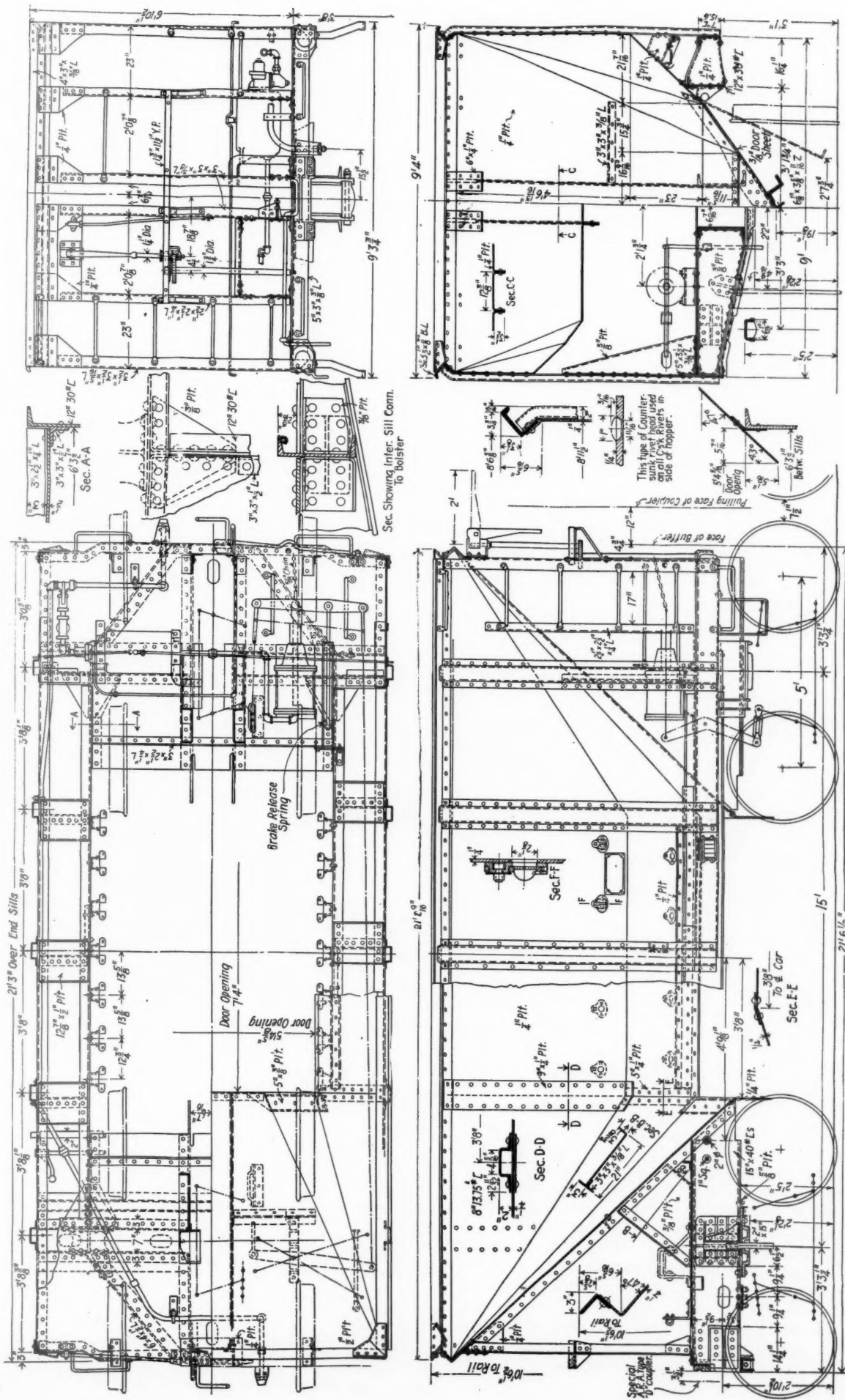
ing that does not permit the use of a continuous center sill. It is, therefore, necessary to construct the car so that the pulling and buffing stresses can be transferred from the draft sills to a set of intermediate sills situated outside of the drop doors which form the bottom of the hopper.

The center sills consist of two 15-in., 40-lb. channels extending from the end sills to the center door opening. A ⅝-in. deck plate, to which the upper flanges of the channels are riveted, is reinforced by diagonal struts extending from the connection between the center and end sills to the bolsters at a point opposite the intermediate sill connections. The center sills are cut off and joined to

back, extend from bolster to bolster, thus providing for a clear door opening 7 ft. 4 in. long and 5 ft. 4½ in. wide. The side sills are 7-in., 15.6-lb. channels extending from end to end of the car. Diaphragms of pressed steel with ½-in. cover plates connect the intermediate side posts. Gusset plates are used at all corner connections to eliminate torsional stresses as far as possible.

The top rail of the car body is 5 in. by 3½ in. by ⅜ in. bulb angle canted in such a way that no iron ore can become lodged in the top rail or its connections. The side and end sheets and stakes are bent to conform with the canting of the top rail.

The side stakes, of which there are five on each side



General drawing of the Chicago & North Western 70-ton ore car



All-steel twin-hopper car built for the Cambria & Indiana by the Bethlehem Steel Company

Car orders placed during 1926

Passenger cars ordered show results of efforts to secure improved designs and facilities—Fewer freight cars ordered last year

THE orders for freight cars placed during 1926, for service in the United States totaled, according to compilations of the Railway Age, less than 67,500 cars. The exact figure of 67,029 given in Table I, compared with the 92,816 ordered in 1925, the 143,728 in 1924, and the cars ordered in preceding years, show that the number of freight cars ordered last year for service in the United States is the lowest since 1921. The same situation, however, does not exist in Canada, for the 1,495 cars ordered last year compares quite favorably with the number of cars ordered each year since 1921. Last year's orders by Canadian railroads is more than twice the number ordered in 1925 and 1922, but are less than 1924 and 1923, when 1,867 and 8,685 freight cars were ordered, respectively. The Canadian freight car orders for 1926 are divided among three railroads and manufacturers, the Canadian Pacific being the heaviest purchaser. Only 42 freight cars were ordered in Mex-

On the other hand, the railways in Canada reported orders for 236 passenger train cars, the largest number ordered since 1923, when 263 were ordered. Last year's passenger train car orders in Canada were divided between the Canadian National and the Canadian Pacific,

Table II—Orders for passenger cars since 1918

Year	Domestic	Canadian	Export	Total
1918.....	9	22	26	57
1919.....	292	347	143	782
1920.....	1,781	275	38	2,094
1921.....	246	91	155	492
1922.....	2,382	87	19	2,488
1923.....	2,214	263	6	2,483
1924.....	2,554	100	25	2,679
1925.....	2,191	50	76	2,317
1926.....	1,868	236	58	2,162

the latter being the heaviest purchaser as was also the case for freight cars and locomotives.

It will be seen in Table III that the freight car production in the United States totaled 88,862, as compared with 105,935 in 1925, and 113,761 in 1924. These figures should not be confused with the orders placed, nor should the total number of freight cars built be compared with the installation of the cars reported in the statistics issued monthly by the Car Service Division of the American Railway Association, as that report includes only installations on Class I roads, while the Railway Age figures include the production of all cars for the railroads, as well as private car lines. Also the Railway Age totals include only new cars or those having new bodies, whereas the Car Service Division totals include leased and rebuilt cars.

A total of 91,633 freight cars were built in the United States last year, of which 88,862 were for domestic service and 2,771 for export. A total of 1,645 freight cars were built in Canada, all of which were for domestic

Table I—Orders for freight cars since 1918

Year	Domestic	Canadian	Export	Total
1918.....	114,113	9,657	53,547	177,317
1919.....	22,062	3,837	3,994	29,893
1920.....	84,207	12,406	9,056	105,669
1921.....	23,346	30	4,982	28,358
1922.....	180,154	746	1,072	181,972
1923.....	94,471	8,685	396	105,552
1924.....	143,728	1,867	4,017	149,612
1925.....	92,816	642	2,138	95,596
1926.....	67,029	1,495	1,971	70,495

ico; they were ordered by the Mexican Railways to be built in company shops.

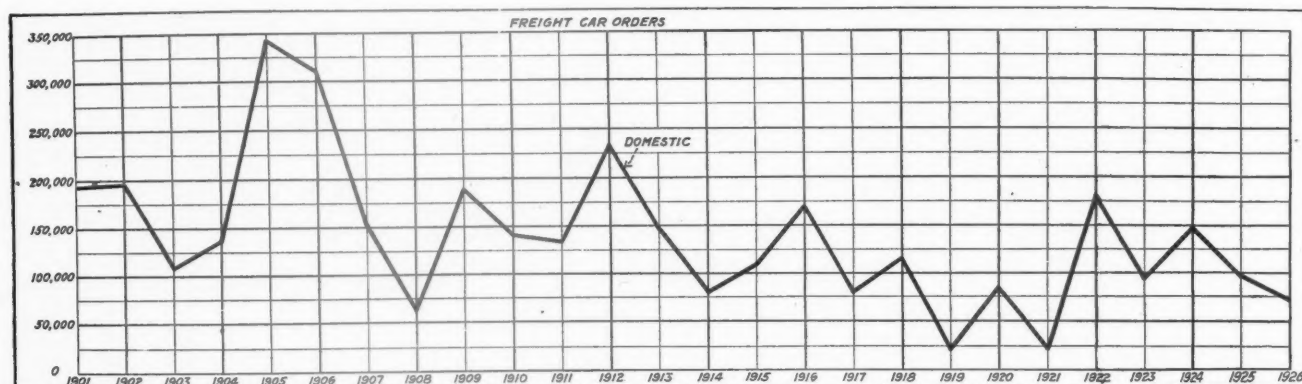
Orders placed in 1926 for passenger train cars for service in the United States totaled 1,868. This again, as shown in Table II, is somewhat similar to the freight car situation for last year, the number of passenger cars ordered last year being smaller than any year since 1920.

service. The total number of cars built last year is smaller than in any year since 1922, when only 66,289 were built.

The Pacific Fruit Express placed the largest freight car order during 1926, ordering a total of 5,043 60,000-lb. steel underframe refrigerator cars, the order being

for 2,250; and the Union Pacific, for 2,050. The Canadian Pacific ordered 1,000 cars during 1926.

The types of freight cars ordered in 1926 for service in the United States and Canada are shown in Table IV. None of these cars are of unusual capacity, except that a number of orders for 70-ton hopper cars were placed



Freight car orders, 1901 to 1926

divided among five builders. The Baltimore & Ohio was also a heavy purchaser of freight cars, ordering a total of 3,016, of which 2,000 were 140,000-lb. capacity all-steel hoppers, 1,000 were automobile cars and 16 were air

last year. The principal orders for cars of this capacity were 2,000 placed by the Baltimore & Ohio; 500 by the Lehigh Valley and 2,000 by the Norfolk & Western. The Canadian Pacific ordered 375 coal cars of 152,000-lb. capacity, which is the largest capacity of any freight cars ordered last year. Several other railroads placed small

Table III—Freight cars built in 1926

	United States			Canadian			Total
Domestic	88,862			1,645			90,507
Foreign	2,771			....			2,771
Total	91,633			1,645			93,278

	United States			Canadian			Grand Total
1913....	176,049	9,618	185,667	22,017	....	22,017	207,684
1914....	97,626	462	98,088	6,453	....	6,453	104,451
1915....	58,226	11,916	70,142	1,758	2,212	3,970	74,112
1916....	111,576	17,905	129,421	....	....	5,580	135,001
1917....	115,705	23,938	139,643	3,658	8,100	11,758	....
1918....	67,063	40,981	108,044	14,704	1,960	16,664	124,708
1919....	94,981	61,783	156,764	6,391	30	6,421	163,185
1920....	60,955	14,480	75,435	....	....	....	....
1921....	40,292	6,412	46,704	8,404	745	9,149	55,853
1922....	66,289	1,126	67,415	458	100	558	67,973
1923....	15,748	2,418	18,166	....	....	....	....
1924....	113,761	1,141	114,902	1,721	....	1,721	116,623
1925....	105,935	3,010	108,945	....	....	....	....
1926....	88,862	2,771	91,633	1,645	....	1,645	93,278

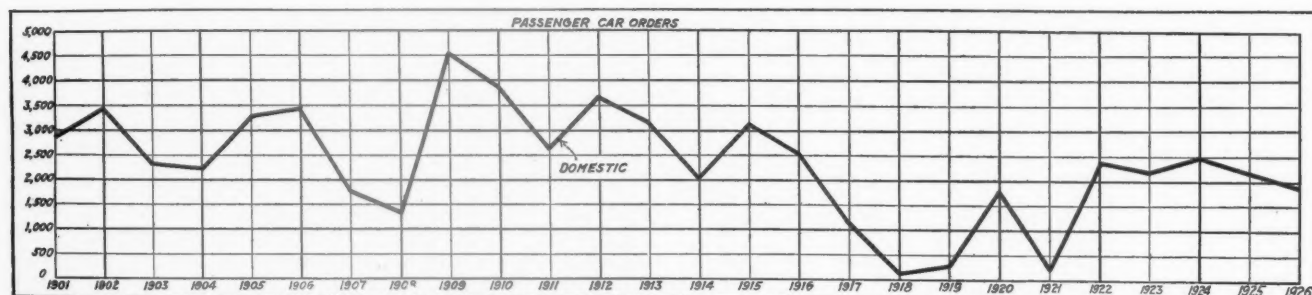
dump cars of 20 cu. yd. capacity. The Illinois Central ordered 3,354 freight cars, of which 1,000 were single sheath box cars of 80,000 lb. capacity, and 2,100 were coal cars of 100,000 lb. capacity. Other large purchasers

Table IV—Types of freight cars ordered in 1926 for use in the United States and Canada

Type	Number	Per cent
F.—Flat and logging.....	2,846	4.1
G.—Gondola	8,849	12.9
H.—Hopper	13,033	19.0
R.—Refrigerator	1	....
S.—Stock and poultry.....	2,065	2.9
T.—Tank	4,067	5.9
X.—Box	16,055	23.6
Automobile	5,674	8.2
Ballast, dump and ore.....	2,658	3.9
Not classified.....	2,192	3.2
N.—Caboose.....	596	.8
Total	68,544	100.0

orders for 140,000-lb. capacity gondola and flat cars. Orders for 16,055 box cars, or 23.6 per cent of all cars ordered, 13,033 hopper cars, or 19 per cent, and 10,489 refrigerator cars, or 15.5 per cent, were placed during 1926.

No new standard car designs have been adopted during



Passenger car orders, 1901 to 1926

were the Southern, with orders for 3,350; the Norfolk & Western, for 2,525; the Chicago & Northwestern, for 2,500; the Pennsylvania, for 2,100; the Louisville & Nashville, for 1,575; the New York Central, for 2,559; the Seaboard Air Line, for 3,450; the Southern Pacific,

the past year. The Committee on Car Construction at the Atlantic City convention of the Mechanical Division in June, however, asked for authority to proceed with proposed standard automobile car designs and a standard self-clearing hopper car. As a result of the recent letter

ballot, the committee is authorized to proceed with the design of 40- and 50-ton automobile cars for unrestricted interchange, with an inside height of 9 ft. 3 in. and an inside width of 8 ft. 7 $\frac{3}{4}$ in. The question of preparing a standard design for restricted interchange with an inside width of 9 ft. 2 in. and an inside height of 10 ft., and whether the door width shall be 10 ft. or 12 ft. on both the unrestricted or restricted clearance cars was not conclusively settled either way by the letter ballot. The result of the letter ballot on the height of the hopper cars

Table V—Passenger cars built in 1926

	United States			Canada			Total
	Domestic	Foreign	Total	Domestic	Foreign	Total	
Domestic	2,184			285			2,469
Foreign	102						102
	2,286			285			2,571

Year	United States			Canadian			Grand Total
	Domestic	Foreign	Total	Domestic	Foreign	Total	
1913.....	2,559	220	2,779	517	...	517	3,296
1914.....	3,310	56	3,366	325	...	325	3,691
1915.....	1,852	14	1,866	33	...	33	1,900
1916.....	1,732	70	1,802	37	...	37	1,839
1917.....	1,924	31	1,955	45	...	45	2,000
1918.....	1,480	92	1,572	1	...	1	1,503
1919.....	306	85	391	160	...	160	551
1920.....	1,272	168	1,440	...	...	...	...
1921.....	1,275	39	1,314	361	...	361	1,675
1922.....	676	144	820	71	...	71	891
1923.....	1,507	29	1,536	...	...	...	...
1924.....	2,150	63	2,213	167	...	167	2,380
1925.....	2,363	50	2,413	...	...	...	...
1926.....	2,184	102	2,286	285	...	285	2,571

was also inconclusive and a further letter ballot will be required before the committee can proceed with the preparation of this design.

Passenger car orders

As shown in Table II, the Canadian railroads reported orders for 236 passenger train cars, of which 179 were ordered by the Canadian Pacific. The production of passenger cars for service in the United States, shown in Table V, totaled 2,286, of which 2,184 were for domestic service. This figure compares favorably with the production figures for the two years preceding 1926.

Table VI shows the types of passenger train cars ordered for service in the United States and Canada during

Table VI—Types of passenger equipment ordered for use in the United States and Canada

Type	1924	1925	1926
Coach, combination passenger, etc.....	952	650	432
Multiple unit coaches and trailers.....	...	...	25
Sleeping, parlor, chair, etc.....	543	535	542
Dining	133	112	111
Baggage, express, mail.....	555	739	435
Express refrigerator.....	410	10	125
Milk	12	80	60
Horse	34	16	95
Private, business, miscellaneous.....	15	17	67
Total	2,654	2,241	2,104

1926. Orders for sleeping, parlor and chair cars totaled 542, while the next largest group ordered last year was 435 baggage, express and mail cars. Various types of coach equipment ordered amount to 432 cars, nearly as many as the sleeping, parlor and chair cars. The largest single railroad order for passenger train cars was placed by the Pennsylvania when it ordered 326 cars of various types in the months of January, April, June and December. Other large orders placed by railroads during 1926 were 73 for the Baltimore & Ohio; 114 for the Long Island; 55 for the Louisville & Nashville; 77 for the New York Central; 80 for the Seaboard Air Line; 75 for the Southern, and 62 for the Union Pacific. The Pullman Company built a total of 481 cars for its own service in its own shops.

Developments in passenger car design

Interest in the roller bearing for use on passenger car journals has greatly increased during the past year. The Pennsylvania has had a number of passenger cars equipped with such bearings for several years and the number of cars so equipped has been materially increased during 1926. The Chicago, Milwaukee & St. Paul will have 127 cars, including 64 Pullmans, equipped with such bearings within the next few months.

Experimental installations of several types of bearings have now been in service long enough to demonstrate clearly that such bearings can be made mechanically reliable and to indicate that their use will probably effect a material saving in maintenance and servicing costs, as well as a material reduction in starting resistance and a somewhat smaller reduction in running resistance within the range of passenger train speeds.

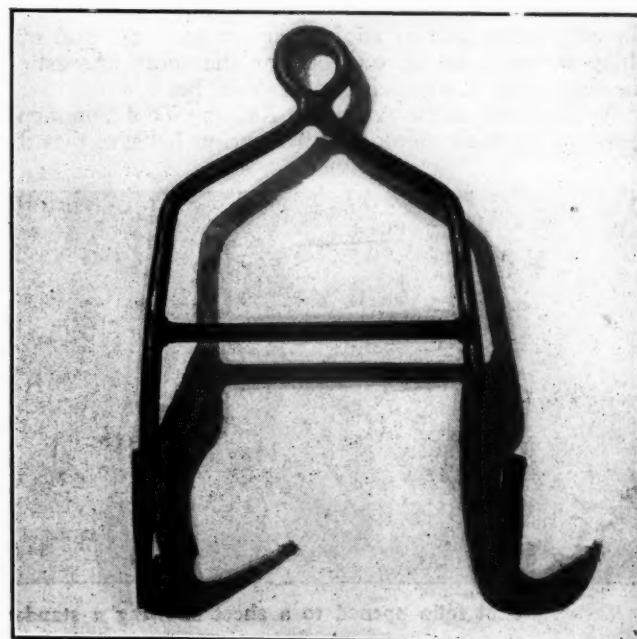
Most of the recent interest in passenger equipment has had to do more with its interior and exterior finish than with structural design. Beauty and harmony of color and decorations have become a definite objective in the interior finish of passenger cars on many railroads during the past two years, and a realization that the value of beauty is enhanced if it appears in varied forms.

Hook for lifting car axles

By J. R. Phelps

Apprentice instructor, A. T. & S. F., San Bernardino, Cal.

THE hook or sling shown in the illustration is designed for lifting locomotive tender or car axles, with or without wheels, in and out of a wheel lathe. While the design of this hook is not uncommon, the



Reinforced hook designed for lifting car or locomotive tender axles in and out of a wheel lathe

attention of the reader is directed to the piece of $\frac{3}{8}$ -in. boiler steel electrically welded around the back and under the bottom of the carrying portion of the hook. This gives the hook extra strength where it is needed the most and eliminates the possibility of the hook straightening out under a heavy load. At the same time the upper parts of the hook may be of lighter construction but sufficient to carry the load safely.



Milwaukee standard tool folio

General outline of a method followed in standardizing
small purchased and shop-made railroad tools

By O. D. Kinsey

Tool supervisor, Chicago, Milwaukee & St. Paul, Milwaukee, Wis.

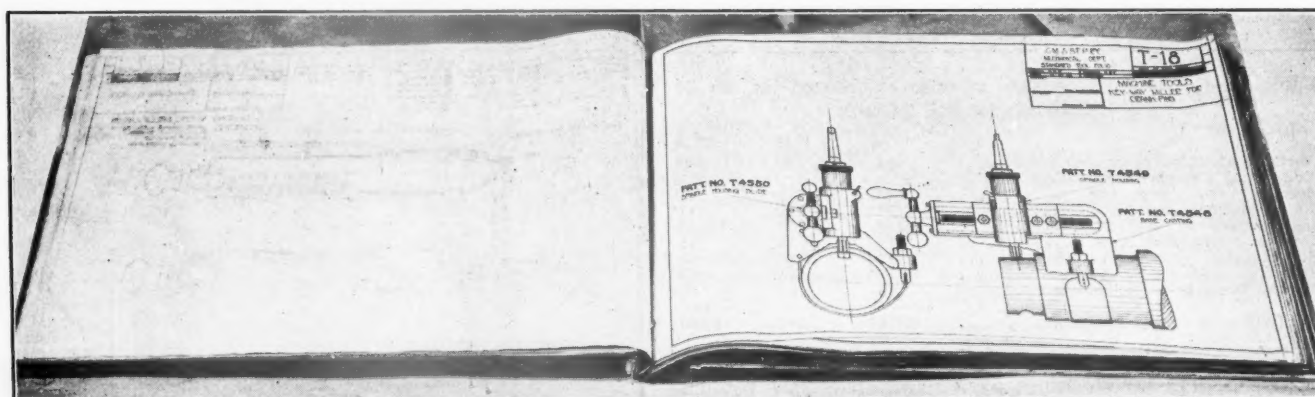
THE growing interest in better tool equipment was indicated among other things by the increased attendance at the recent convention of the American Railway Tool Foremen's Association at Chicago, when several new tool supervisors joined the ranks of the association and in addition many new tool and machine foremen sat in one of the most interesting meetings that this association has ever held.

As president of the American Railway Tool Foremen's Association this coming year, the writer believes that the

in service, such as assignment records, breakage records, tool tests, etc., could well be standardized and made available to all roads.

The Chicago, Milwaukee & St. Paul does not claim to be the pioneer in establishing a centralized tool system; it has had the advantage of opportunities to size up what certain progressive roads have accomplished and profit by their experience.

The tool catalog is obviously the foundation for the tool system, in other words, the master book of standard



Tool folio opened to a sheet showing a standard crank pin keyway miller used on C. M. & St. P.

organization, through co-operative effort of this kind, has an enviable opportunity to serve the American railroads by developing standard and efficient tool equipment and a uniform system for cataloging and handling such standards when established.

Now is the opportune time to agree on a national standard tool system and adopt a uniform tool folio or catalog, in order that drawings may be of uniform size and interchangeable between as many roads as possible. Also various records required for keeping track of tools

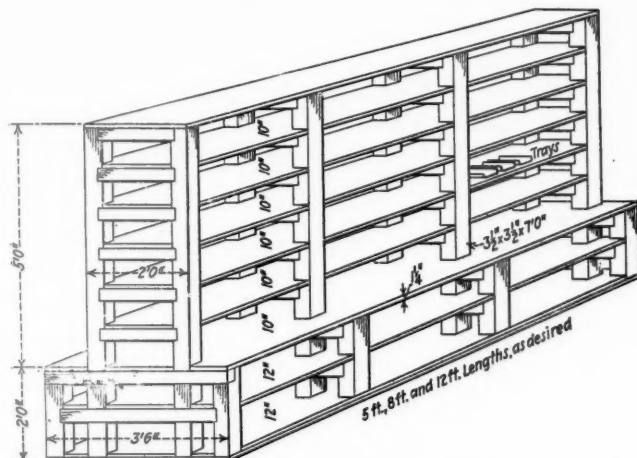
practice. The Chicago, Milwaukee & St. Paul has adopted a catalog sheet equal in size to a double standard letter head, namely 11 in. wide by 17 in. long. This size when folded once equals a standard letter sheet 8½ in. by 11 in., permitting convenient attachment and filing therewith.

These sheets are laid out and punched as illustrated and they fit a standard commercial loose leaf binder as shown by another illustration. Suitable index sheets are provided in the front section of the book. These

are made by the Van Dyke method which affords a white field for writing in additional entries, as received by holders of the books.

We now have approximately 150 books or catalogs in circulation, assigned to master mechanics, general foremen, roundhouse foremen, storekeepers, and car foremen over the Chicago, Milwaukee & St. Paul system.

Both commercial standard tools and our own special



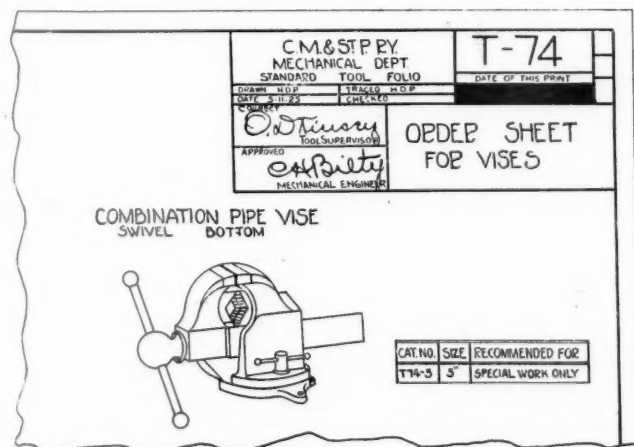
Design of standard toolroom rack for small tools

tools and labor-saving equipment are listed in the catalog which is added to and revised from time to time to keep it strictly up to date.

Method of developing tool folio

Tool standardization is controlled by the general tool supervisor in co-operation with tool committees representing the several departments and crafts on the railroads.

The tool supervisor, with the assistance of an experienced tool designer, investigates and develops suggestions



Part of a tool folio order sheet for bench vises, showing the name plate details

made by supervisors and employees recommending better equipment, tools, or methods.

These suggestions are carefully studied and developed systematically, and finally the best solution, covered by a drawing, is submitted to the mechanical engineer, who upon approval resubmits it to the final committee for comment and approval. If approved by this committee, it is then submitted to the general superintendent of

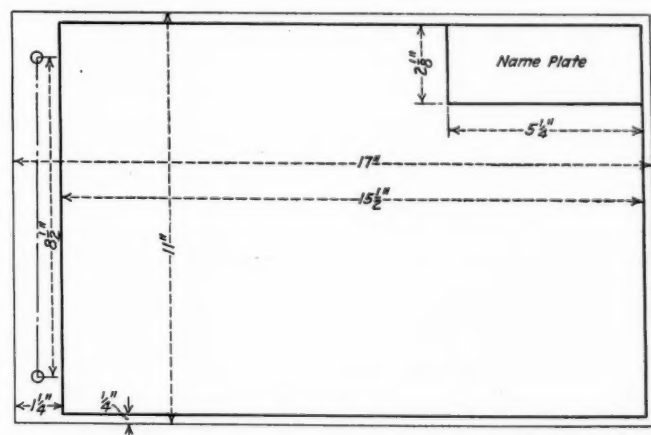
motive power for his acceptance, after which it is entered in the standard tool folio or catalog as standard practice.

This insures a progressive, uniform upbuilding of tool equipments always subject to revision as improvements are suggested and better tools are developed. Old prints are then recalled and new prints sent out.

Special tools and labor-saving equipment such as are manufactured by the central tool department, if small enough to draw in detail on the standard tool folio sheet, are mounted on card boards and used by the tool makers as a manufacturing reference. If too large to show in detail we make a picture drawing for the catalog and use the standard drawing room sheets for the details.

Before this system was started, tools were being made all over the railroad and by hit and miss methods, usually duplicating worn-out samples or depending on the ingenuity of a local machinist. Now we have installed a system tool room, described on page 359 of the June 1, 1926, *Railway Mechanical Engineer*, which is fully equipped with modern machine tools, a heat-treating and a grinding department.

Men skilled in tool work and specialized in the several branches of the art are now producing better tools at much lower cost. Suitable grades of tool steel are



Dimensions of standard sheet used in C. M. & St. P. tool folio

now available and through specialization a better understanding of materials and their proper utilization is obtained.

Generally speaking, we do not attempt to manufacture standard commercial tools, but confine our efforts to special labor-saving equipment and various special tools required for maintaining and extending the service life of locomotive appliances, namely, air brake equipment, stokers, superheaters, headlight generators, injectors, blowoff cocks, check valves, reverse gears, valve gears, and general locomotive machinery.

Centralization of tool facilities is gradually tightening up on tolerances and improving the general standard of workmanship. Uniform gage systems are being established, screw thread practice is being improved by closer tolerances. Better tool equipments are now available of a much higher order than before.

Standard tool racks and steel enclosure

An example of the attempt to secure uniformly good tool room practices on the system is afforded by the standard daylight tool rack illustrated, which has been designed for installation in as many units as required, and surrounded by a sheet metal and wire mesh enclosure.

sure which also promotes better daylight working conditions in the toolroom. These racks are being built at shop points having planing mill facilities to insure low cost and substantial construction. They are 5 ft., 8 ft., or 12 ft. long to suit local conditions, being made in other details according to the drawing. It is recommended that checkboards, 2 ft. by 5 ft., be mounted on the tool rack ends towards the windows, allowing 3 ft. of space between the checkboards and front of the counter. The racks are spaced 2 ft. apart at the base and are painted white and gray. Suitable sheet metal trays 4 in. and 6 in. wide are provided for holding taps and similar tools.

A steel enclosure is provided for the standard tool-room. It is made of 2-in. diamond mesh, No. 9 gage wire for the upper part of the partition, and No. 16 sheet steel 42 in. high for the panel base. Standard sections are 9 ft. high and 6 ft. wide, with a sliding door 4 ft. wide by 7 ft. high set in a panel 9 ft. high. The partitions are all painted green. If mounted on top of a counter, they are ordered 8 ft. high, the serving windows being made locally at erection.

Air pump piston swab wrapping machine

By John D. Flinner

Supervisor of air brakes, Monongahela, South Brownsville, Pa.

SHOWN in the drawing is a small portable device for wrapping piston swabbing and torch wick on tin strips for making air pump piston swabs. The gears are scrapped gears taken from an old machine tool. In this

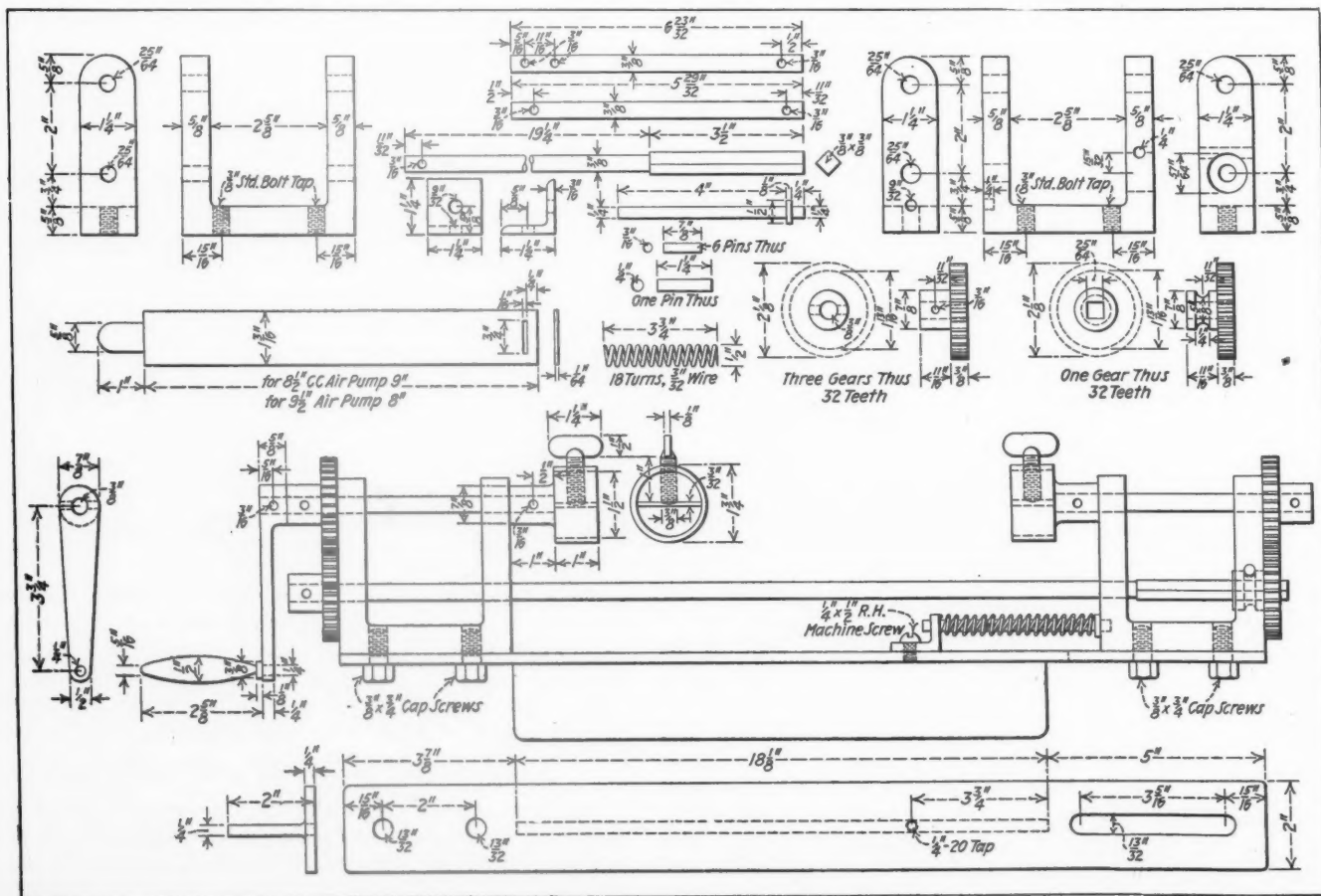
machine the gears are all the same size, but four gears of any small size found around the shop will be satisfactory. The base is made from a 2-in. by 2-in. by $\frac{1}{4}$ -in. tee, the leg of which is clamped in a vise when the machine is in use.

The tin strips are clamped in the two chucks, and are held in place by tightening the thumb screws. They are cut $1\frac{3}{8}$ in. wide and 9 in. long for $8\frac{1}{2}$ -in. cross compound compressors and 8 in. long for the pistons of $9\frac{1}{2}$ -in. compressors. The dimensions of the tin strips used are shown at the left center of the drawing.

BRITISH BUILT LOCOMOTIVES FOR CHILE SHOW AMERICAN INFLUENCE.—Two British built Garratt-type locomotives, combining features of both British and American practices in locomotive building, have been placed in operation on the Nitrate Railways at Iquique, Chile, according to a report from Harry Campbell, American Consul at Iquique, in Commerce Reports.

The locomotives were built in Manchester, England, by Beyer, Peacock & Co., and are said to be the most powerful of the type ever built. They were constructed in accordance with specifications submitted by the locomotive superintendent of the Nitrate Railways, for the particular work of hauling freight trains from Iquique to Carpas, a distance of about 20 miles, and over a gradient as great as 3.9 per cent.

The more important American features of the locomotives are the bar type of frame, cylinders cast integrally with half of the frame stay, crosshead guide bars of the double American type above the piston rod, grease lubrication in accordance with the latest American practice, spring rigging placed above the driving boxes, boilers with steel fire boxes, stayed with iron staybolts, American type combined feed water heaters and pumps and water-purifying apparatus, connecting rod back end bearings of the American floating type, and air brakes of American design. A third locomotive of the same type is under construction in Manchester, and will be delivered in two or three months.



Detail construction of the air pump piston swab wrapping machine

Apparatus for grinding locomotive joints

Cylinder heads, valve heads, dry-pipes, nozzles and other joints finished with the same device

By L. V. Mallory

Division foreman, Missouri Pacific, Lexa, Ark.

THERE are many methods of grinding locomotive cylinder heads, valve heads and dry-pipe joints in various railroad shops, but it has never come to the writer's attention that any one device has been designed for more than one purpose. In order to design a device which can be used to finish all of the locomotive parts mentioned above, it was necessary to de-

sages C-1 and C-2, connect the reversing valve chamber with the reversing piston chamber. The air enters the reversing piston chamber near its outer end. The passages D-1 and D-2 connect the main valve chamber with the main cylinder at a point near its outer ends.

The main exhaust ports B-B are drilled on a horizontal line with the main air supply port and communicate

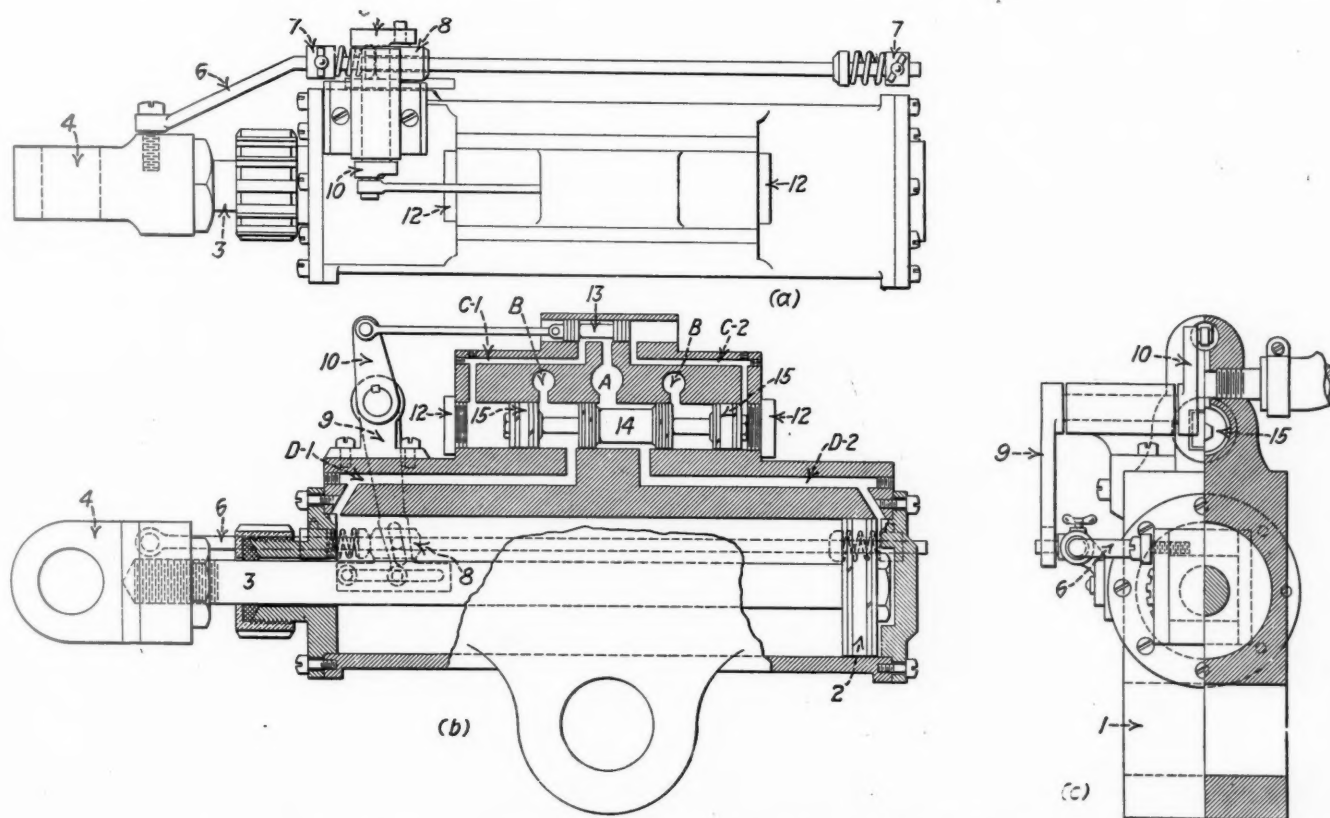


Fig. 1—The oscillating cylinder for grinding in a variety of joints

sign one prime mover to operate the mechanism of the device for the various operations.

This prime mover is in the form of a pneumatic oscillating cylinder, with a variable piston travel. The cylinder body 1, Fig. 1 (a) is made of cast iron. It is bored for three chambers. The upper chamber is for the reversing valve 13, Fig. 1 (b); the second bore from the top forms the chamber for the main valve and reversing pistons 14 and 15 and the largest bore forms the main cylinder chamber in which the main piston 2, reciprocates.

The main air supply port A is centrally drilled between the two valve chambers so as to supply air to the reversing valve 13 and the main valve 14. Two pas-

through short passages with the main valve chamber at points between the reversing pistons 15 and the exhaust ends of the main valve 14. The reversing valve 13 is connected by a reversing rod to the vertical rocker arm 10, Fig. 1, (c), which in turn, is keyed to the trip lever shaft 9. The trip lever engages with a pin fixed in the trip rod crosshead 8. The trip rod 6 is connected by a small pin to the main driving knuckles and slides freely through the crosshead. The trip rod carries the two trip collars 7-7 which are adjustable and secured to the trip rod by small set screws. The trip collars are so located on the trip rod that the crosshead 8 is between them. The small coil springs and free collars that are also carried on the trip rod absorb the

shock of the trip collars against the crosshead. In the long slide at the bottom of the crosshead is a slot which engages two small pins set in the cylinder body in such a manner that the crosshead can travel enough to give the reversing valve its necessary travel.

The main valve 14 is connected tandem with and centrally between 15-15, the reversing pistons. The main valve chamber is closed at each end by the two caps 12.

The cylinder body is cast so that it has a large lug located centrally on its under side and at a right angle to the cylinder bore. A hole is drilled transversely through the lug so that it will slide freely over the fulcrum shaft of the driven grinding apparatus.

The principle of operation is simple. Assuming that the main piston is now at the rear end of the cylinder, as shown in Fig. 1 (b), the trip lever 9 is moved forward by the trip collar. This action places the reversing valve 13 at the extreme forward limit of its stroke, thus connecting the main supply port *A* with the port

its stroke regardless of the length of travel, be it one inch or twelve.

Cylinder and valve chamber head grinding device

The oscillating cylinder just described is used to drive a device for grinding cylinder and valve chamber heads. This machine consists of a fulcrum shaft 2, Fig. 2, made of 2-in. cold rolled steel, suspended at the cylinder end by an anchor bracket and at the other end by the vertical support post assembly 13, 19 and 20 which is attached to the pilot beam, as shown in Fig. 2, when grinding front cylinder-heads and to the guide seat of the guide yoke when grinding back cylinder-heads, as shown in Fig. 3.

The anchor bracket 17, Fig. 2, is secured to the cylinder casting by the valve chamber studs when grinding a cylinder-head and to the cylinder-head studs when grinding a valve-chamber head. It is made long enough to extend across the largest cylinders. It has two longitudinal slots cut in it that permit it to be adjusted to

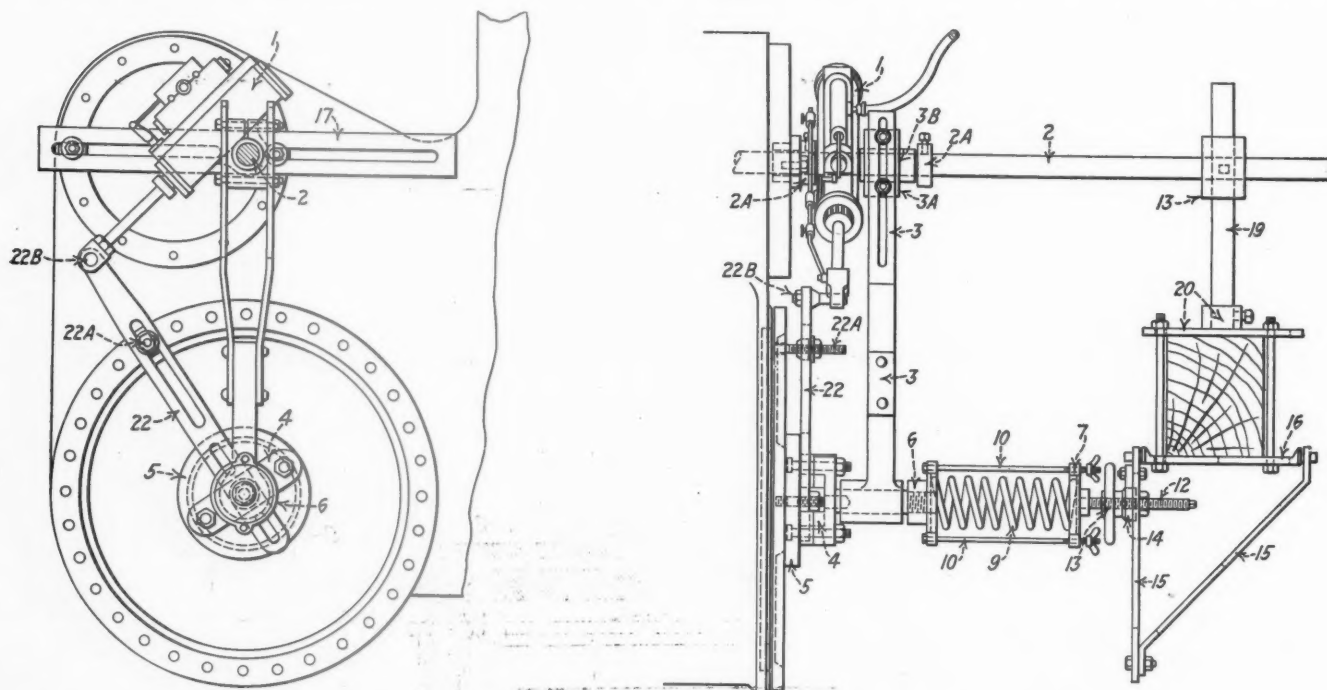


Fig. 2—Method of applying apparatus when grinding in front cylinder heads

C-1 leading to the forward reversing piston chamber. The air thus admitted forces the reversing piston 15 backward, carrying the main valve with it which connects the main cylinder admission port *D-2* to the main air supply port *A*. Air is thus admitted behind the main piston which is forced forward until the rear trip collar strikes the trip lever crosshead and carries it forward. This moves the reversing valve to the back limit of its travel. Port *C-2* is now open to the main supply port *A* and the upper end of the port *C-1* is open to the air in front of reversing piston 15 to escape through the open end of the reversing valve chamber to the atmosphere. The main valve then moves forward, reversing the positions of ports *D-1* and *D-2* with respect to the air supply *A* and the exhaust ports *B*.

The travel of the main piston can be regulated by changing the position of the trip collars on the trip rod. The reversing pistons will always be at either extreme until the position of the reversing valve is reversed. This feature insures a wide open port and unrestricted air pressure to act on the main piston for the duration of

line with the fulcrum rod directly over the center of the cylinder as shown in Figs. 2 and 3.

The fulcrum rod is a sliding fit through the anchor bracket, vertical support bracket, the hanger sleeve 3B of the swivel block hanger assembly 3, 3A and 3B, Fig. 2. The lug of the oscillating cylinder is also provided for this purpose.

The two collars 2A are secured to the fulcrum rod by set screws and hold the operating cylinder and hanger in alignment with the connection to the cylinder-head. The bracket 13 can be adjusted and secured to the vertical support post by set screws, to maintain the fulcrum rod in a horizontal position.

The swivel block hanger consists of an old locomotive link hanger, cut off as shown in Fig. 2, to which are riveted two legs of $\frac{3}{4}$ -in. by $2\frac{1}{2}$ -in. bar iron with the hanger block 3A clamped between them. Longitudinal slots cut in these legs engage the hanger block bolts, thus affording means of adjusting the length of the hanger 3.

The cylinder head attachment, 4 and 5, consists of an

old link saddle pin and a cast iron disc on the back of which are two bosses in line with those of the old link saddle. This arrangement provides space for applying and tightening nuts on the cylinder-head casing stud that secures the swivel block to the front cylinder-head or valve-head. It also provides clearance for the oscillating lever 22. Two slots are cored in the disc at 90 deg. from the bosses, long enough to fit over the piston gland studs of back cylinder-heads of different designs. This provides means of attaching the back cylinder-heads to the swivel block assembly. The two parts of this assembly are bolted together with two round headed bolts the heads of which set into counter-bored holes.

A coil spring seat 6 is drilled and threaded to engage with the threaded end of the old link saddle pin and transmits the pressure of the tension coil spring 9 to the cylinder-head. The tension is set by the adjustment assembly which consists of the spring seat 7, adjusting screw 12, adjusting wheel 13, adjusting screw guide 14 and the bracket 15. The adjusting screw bracket is hinged to a horizontal bar 16, as shown in Fig. 2, which forms a clamp for the fulcrum rod support bracket 20. A slot cut in this bracket permits the alignment of the spring assembly. The diagonal member of the bracket also has a shorter slot to provide clearance for the adjusting screw when it is in its lower positions.

The tension retaining screws, with their wing nuts, which pass through lugs provided for them on the sides of the spring seats, provide a means of retaining the required tension of the coil spring while the adjusting screw is released, as it must be, when sliding the cylinder-head back to inspect the joint.

When the adjusting screw 12 is released, the bracket can be swung out of the way of the coil spring. As the

lower end are two short longitudinal slots so spaced as to engage with the piston gland studs. Located centrally between these slots is a drilled hole of sufficient

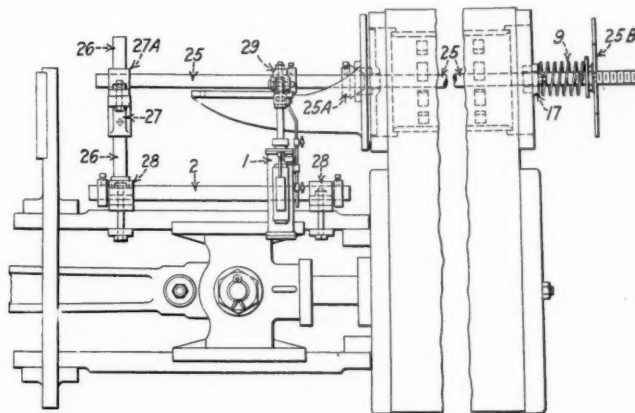


Fig. 4—Set-up for grinding in a back valve chamber head when the crosshead and main rod are not removed

size to engage with the largest stud that might be used for securing the casing to the front cylinder or valve heads.

A longer slot engages the driving pin 22A which is inserted in one of the cylinder-head stud holes.

Apparatus and set-up for grinding rear valve chamber heads

As it is often necessary to grind back valve heads when there is no occasion for disturbing other parts of the locomotive, an apparatus has been designed whereby

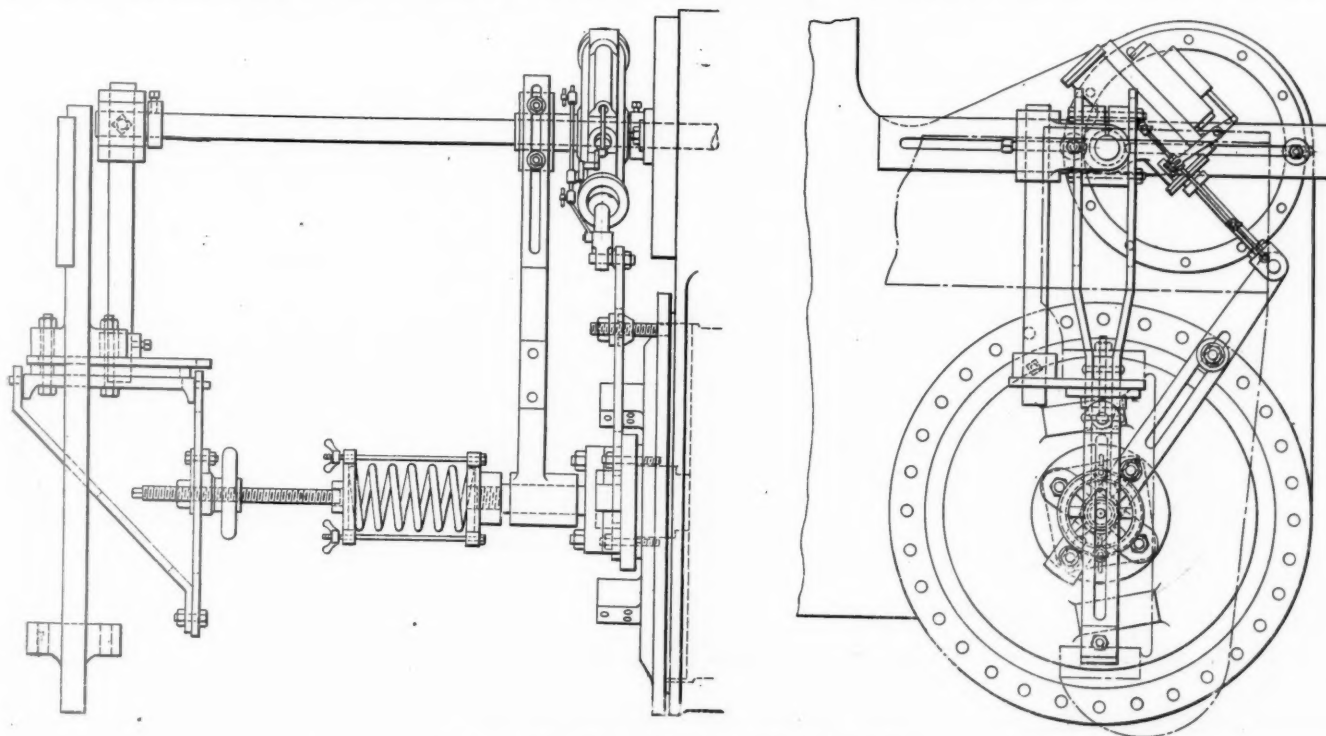


Fig. 3—Grinding in back cylinder heads

fulcrum rod is free to slide in its support, the entire apparatus, including the cylinder-head thus suspended, may be slid back for inspection of the work and for the application of more grinding material.

An oscillating lever has a hole drilled in its upper end in which is fitted the connecting pin 22B. Near its

this can be accomplished in a simple manner. This consists of two anchor rod brackets 28, Fig. 4, attached to the main crosshead guide. These brackets support the anchor rod 2 on which the operating cylinder is fulcrumed.

Secured by the same bolts that hold the back bracket

to the guide, is the vertical post 26, which carries the tension-rod bearing arm 27. This arm is slotted so that the bolts securing the bearing block 27A, may be adjusted laterally in line with the center of the valve chamber bore. An ordinary "old man," used for drilling, is suitable for the vertical post.

The tension-rod 25 may be made of 1 $\frac{3}{4}$ -in. round iron. The tension adjusting wheel is simply a 1 $\frac{3}{4}$ -in. standard hexagon nut spot-welded to a spider made of boiler steel. This nut engages with threads cut on the forward end of the tension rod, on which is suspended the back valve chamber head to be ground by the machine.

The conical thrust collar 25A serves to hold the head firmly against its seat on the valve chamber, while the oscillating lever 29 serves as a bearing for the rear valve stem guides. This feature insures that the back valve chamber head will meet the joint on the valve chamber with equal pressure all around. It prevents the valve head from grinding faster on the bottom, which is usually experienced when grinding by the common method, because there is no provision to support the overhanging weight of the guide portion of the head. This arrangement also affords a convenient means for inspection and of redoping the joint, as the head, tension rod and all can be slid back by releasing the tension adjusting wheel 25B.

In Fig. 5 the method of mounting the valve head on the tension rod is shown in detail. The method used with valve chamber heads having the valve stem guides carried above, is shown at (a) and the method used with

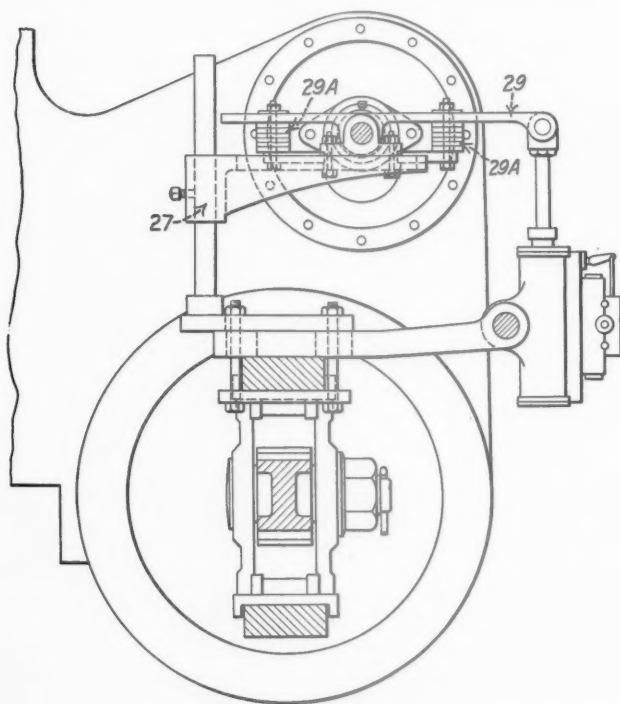


Fig. 5—Two types of oscillating levers are used for the old and new style back valve chamber heads

center hung valve stem guides is shown at (b). The latter style of oscillating lever shown can be used to advantage, however, on overhead hung guides as it has an adjustable center block. When using this set-up it is necessary to invert the oscillating lever, thus eliminating the use of the spacer washers, as the center block can be moved to the desired location. The oscillating lever 29 has longitudinal slots cut in each end to facilitate horizontal adjustments.

Apparatus and set-up for grinding front valve chamber heads

The same apparatus is used for grinding front valve chamber heads, with the exception of the fulcrum rod support brackets, for which the support bracket for cylinder front-heads is substituted.

The fulcrum rod anchor bracket of the cylinder-head

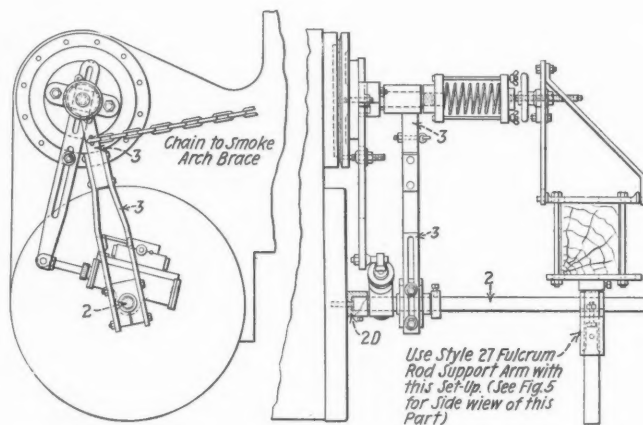
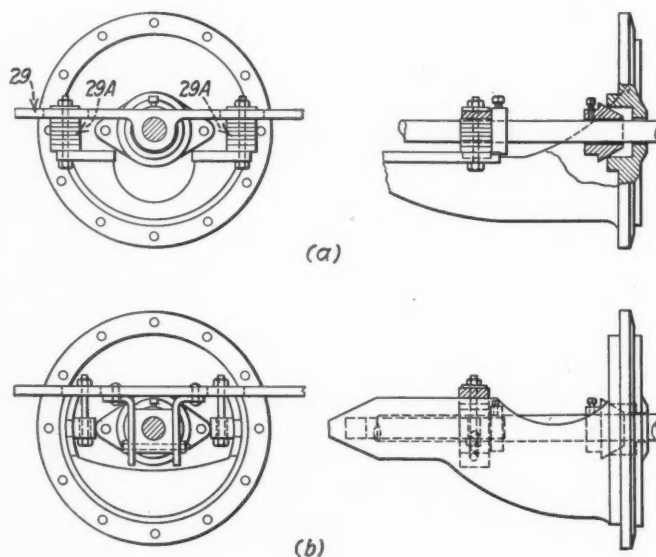


Fig. 6—Set-up for grinding a front valve chamber head

set-up is substituted by the socket 2D, Fig. 6. This socket is a cylindrical piece of iron bored out for two-thirds of its length to receive the end of the fulcrum rod, while the remaining solid end is drilled and tapped



to engage with the cylinder-head casing stud after the nut has been removed. The socket has a hole drilled and tapped on the side to receive a set screw for securing the end of the fulcrum rod in place.

When it is desired to grind the front valve head while the front cylinder head is removed, the fulcrum rod anchor bracket can be used by applying it to the front cylinder-head studs.

This set-up calls for a reversal in the position of the

hanger 3 from that used in the cylinder head set-up. A chain is used to hold the valve head and hanger from swinging downward when it is slid back from the valve chamber seat for inspection of the joint. The chain is attached to the smoke arch brace or any other convenient part of the locomotive.

Grinding a dry-pipe flue-sheet joint

The apparatus used for grinding the flue-sheet joint of a dry-pipe consists of the vertical support 56A and

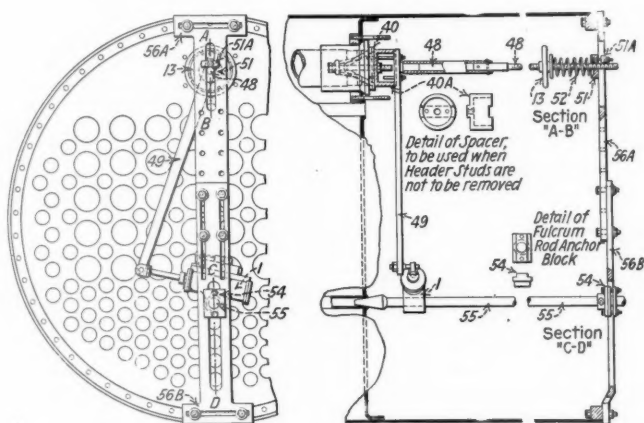


Fig. 7—Arrangement for grinding dry-pipe flue-sheet joints

56B, Fig. 7, which are secured to the front end foundation ring by the front end bolts. This support is composed of two parts. The upper part, 56A, is made of 1-in. by 6-in. bar iron with a transverse slot in its upper end to engage the front end bolts. A longitudinal slot of sufficient width and length to engage with the tension adjusting screw 48 is located near the upper end. Along the sides of this member are a double row of

justable spring seat, 51, is secured in any desired location by the small clamp 51A. The spring seat also serves as a bearing or guide for the tension rod 48. The tension rod consists of a piece of 1½-in. by 2¼-in. steel tubing with a piece of 1½-in. round iron firmly shrunk and pinned in one end. A short piece of turned 1¾-in. round iron slips into the open end of the tubing and fits into a hole drilled in the oscillating lever 49. A collar on this piece takes the thrust of the tension rod. The longer portion of the iron piece fixed in the other end of the tube is turned down to 1¼ in. and threaded to engage the tension adjusting wheel 13.

An internal expanding chuck 40, of simple design, drives the dry-pipe. This chuck is connected to the operating cylinder by means of the lever 49, which may be bolted directly to the chuck when there are no dry-pipe studs to interfere, or may be extended away from the chuck by the spacer 40A when the studs are not to be removed.

The details of the fulcrum rod anchor block 54 are clearly shown in the drawing; the hole through this block for the fulcrum rod is drilled with 1/32 in. clearance and is secured to the rod with a set screw. The fulcrum rod is made of either 2-in. round iron or 2-in. cold rolled steel shafting.

In some of the older types of engines, the dry-pipes are often offset or curved, a condition which necessarily limits the distance the dry-pipe may be oscillated in grinding. In such cases the travel of the piston of the oscillating cylinder must be regulated to a suitably short stroke.

The internal dry-pipe chuck

The internal chuck used for grinding in dry pipes consists of a cone, 40, Fig. 8, which has four grooves milled longitudinally in its surface, located 90 deg. apart. They are milled to a depth of 1 in. and are ¾ in. wide. In these grooves rest the expansion bars 42, which are

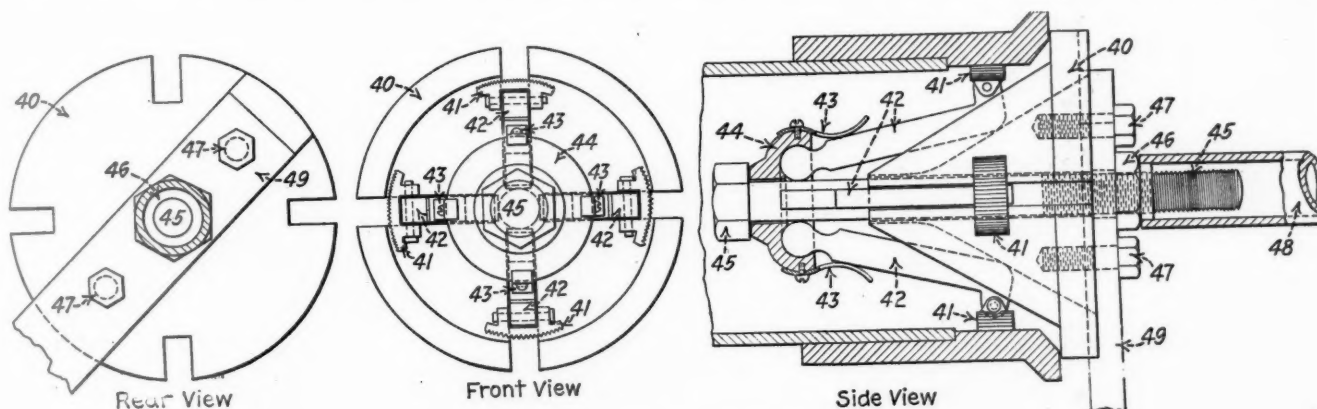


Fig. 8—Details of the dry-pipe chuck

punched or drilled holes, which, together with the slots in the lower member, permit the proper spacing of the clamping bolts that secure the two members together.

The lower support 56B is made of the same material as that of the upper support and is shaped similar to it. This member has a large longitudinal slot near its lower end of sufficient width and length to engage with the fulcrum rod 55, and bearing block 54. This slot permits alignment of the fulcrum rod with one of the small flues near the center of the boiler. There is a short off-set near the bottom of the lower member, the thickness of which permits an accurate line-up with the upper member.

In the longitudinal slot of the upper member an ad-

made of ¾-in. by 1-in. mild steel machined to a thickness that will permit them to slide freely in the grooves. One end of each expanding bar is turned outward at right angles and rounded off to engage with the lugs of the chuck jaws 41. The other ends are so shaped that they form circular heads that engage with the rounded annular groove in the thrust collar 44.

The thrust collar is made of mild steel with a semi-circular groove cut in its face so that when the draw-bolt 45 is in place, a groove is formed with a comparatively small opening on the outside through which the necks of the expansion bars extend. In assembling the chuck the expansion bars are first placed in their respective grooves in the cone. The thrust collar is then

placed over the heads of the expansion bars and the drawbolt inserted, thus enclosing the heads of the expansion bars within the thrust collar.

The chuck jaws are made of tool steel with lugs drilled to receive small pins or cotters that connect them with the expansion bars. It must be understood, however, that these pins are merely to prevent the loss of the jaws when not in use as under pressure the expansion bars bear directly on the bottom of the jaws thus preventing them from coming out.

A channel is cut across the back end of the cone in which the end of the oscillating lever 49 fits snugly. It is secured to the cone by the two cap-screws 47. A $1\frac{3}{16}$ -in. hole is drilled in the oscillating lever through which the drawbolt passes. A $1\frac{1}{8}$ -in. standard hexagon nut engages with the threads of the drawbolt. This nut is turned off so that a round boss is left, over which is slipped the end of the tension rod. Four small flat springs, 43, serve to hold the expansion bars against the cone until pressure is applied.

Welding stoker feed screws

By James S. Heaton

Welding supervisor, Wabash, Decatur, Ill.

OWING to the large amount of locomotive stoker repair work handled at the locomotive shops of the Wabash at Decatur, Ill., a machine for repairing stoker feed screws was designed by E. J. Hausbach, general foreman, which has been of considerable assistance in speeding up the work. Previous to the installation of this machine, stoker feed screws were either

tially of a lathe head and tail stock taken from an old 14-in. lathe and mounted on a bed made of a 10-in. channel. The channel is mounted upon stands which are welded together as shown in the drawing. The lathe head is stationary, and provision has been made for moving the tail stock to suit different lengths of stoker feed-screws by locating holes for the $\frac{3}{4}$ -in. bolts which



View of the cutting machine showing a cut taken from a stoker feed screw

turned down in a lathe and then welded on the edges, or the rods were welded on first and the screws turned down to size afterward. In either case the time for turning down a feed screw would often amount to several hours. The use of the machine, the detail construction of which is shown in the drawing, has reduced the time of turning to approximately a half hour. The screw, when finished, will compare quite favorably with a job performed on a lathe.

Referring to the drawing, the machine consists essen-

hold it in position, as shown on the drawing of the channel.

A runway of $2\frac{1}{4}$ -in. square steel is bolted to supports welded to the bedplate on which the torch carriage is operated. The torch carriage is mounted on four grooved wheels which operate on the corners of the runway or rail. The cutting torch is mounted on the carriage as shown in one of the illustrations. The clamp which holds the torch is mounted in a bevel slide and can be adjusted to the variations of the different thicknesses of

feed screws by means of a compensating screw. The carriage propeller is fitted with a loose wheel which rolls against the screw and moves the torch carriage along the rail as the screw is revolved. This propeller is also mov-



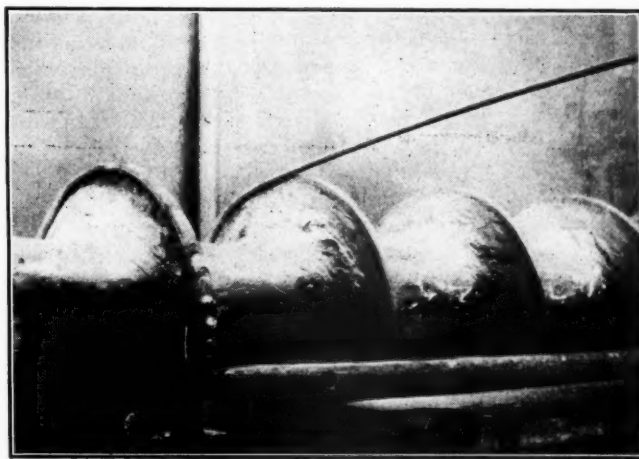
The torch carriage

able, so that it can be adjusted. A guard is welded on the carriage at the bottom, to keep the hot sparks away from the rail.

The carriage rail acts as a straight edge, so that when forming the bars on the screw it is an easy matter to keep within the required limit. The screw is first sanded off, to remove all scale and dirt which may interfere with the cutting. It is then placed between the lathe centers, clamped, and then measured to determine the

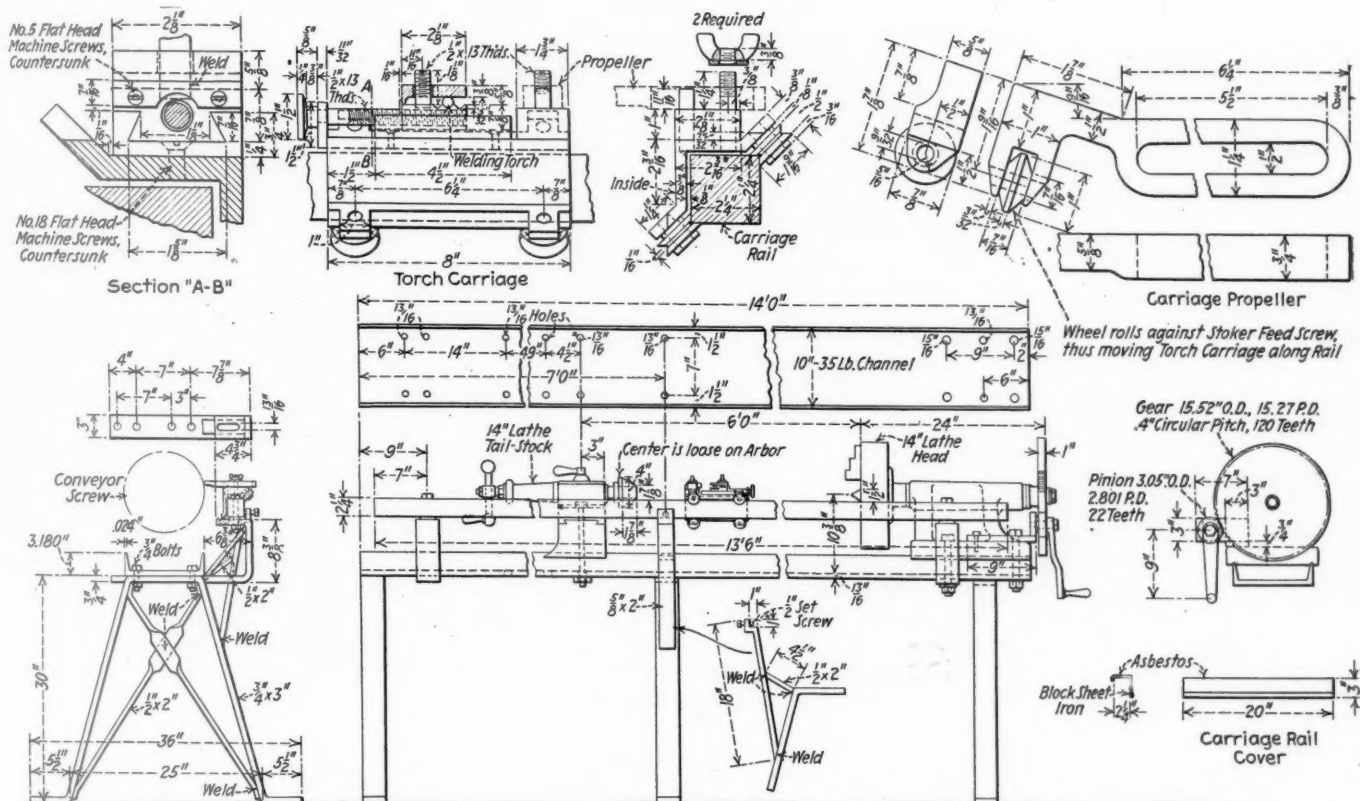
which make them hard to cut unless the carriage is moved very slowly at these places. This eliminates the motor drive arrangement. The time required for cutting a conveyor screw is about 30 min., and for an elevator screw about 25 min.

After the screw has been trimmed, the bars are formed around the edge by heating with an acetylene torch while



Laying the rod on the edge of the screw

the screw is rotated. The bar is hammered in position before the screw is removed from the machine. The screw is then taken from the machine and stood on end



Details of the cutting machine

amount of metal to be removed to obtain a good foundation for the addition of the bars to bring the screw to the proper diameter.

The machine is operated by hand power. It has been found that most of the screws have sand holes in them

and welded by the electric process. More progress can be made with the screw in this position than when it is on the side, and it is easier on the operator. The time required for cutting and welding a screw will average about seven hours.

Defect epidemics from obscure causes

By Warren Ichler

THE word "epidemic" as here used refers to those seemingly inexplicable outbreaks of specific mechanical troubles which suddenly develop to serious proportions and seem to be communicated from engine to engine or car to car, much as a pathological condition develops and spreads in cities and towns. No consideration is given here to such major problems as lubrication, steam leaks, etc., which, like the poor, are always present in some degree; and which, because of their persistence, receive continual attention and investigation. This does not mean that the sieges of mechanical troubles here presented were entirely unrelated to major maintenance problems—in fact, they were all merely acute "cases," to borrow further from medical terminology, of troubles that have been known since locomotives and cars began to run.

Without any desire to be too reminiscent, most of this material has been culled from personal experience—and personal grief. The experience of any mechanical department employee of reasonable length of service would probably be productive of similar observations, based, however, on entirely dissimilar causes and results obtained therefrom.

Heating of engine truck boxes of no apparent reason, under normal or nearly normal service conditions, has probably given rise to as much speculation and tinkering as any other purely mechanical defect developing in locomotives. On one important trunk line on which the writer served as machinist for an extended period, the repair forces at a busy enginehouse were suddenly confronted with the fact that about 40 per cent of the passenger trains were being delayed by hot engine truck journals, after a long period of comparative freedom from this nuisance.

Obviously, the matter was not due to faulty design or maintenance practices for these were "hold-overs," so to speak, from a period of successful operation. It was evident to everyone that the trouble came from some local condition but this gave no clue to a remedy until one day an apprentice remarked that "it sure was queer that only those engines running eastward from the enginehouse were giving trouble."

This opened up a new field of speculation and investigation and the heating trouble was soon definitely allocated to a section of line which was receiving new ballast to counteract subsidence and where unspread and untamped ballast lay banked along the track for some days before it could be finally graded and tamped. Of course, after this much had been learned everyone was ready to comment on the unusually heavy coating of dust and sand found on the leading trucks of locomotives traversing this stretch of track, and on the impossibility of proper lubrication of journals and bearings under such conditions.

That this diagnosis of the trouble was a correct one was evidenced by an almost complete disappearance of hot engine truck boxes when track conditions were restored to normal.

Leaking dome caps

Possibly the most baffling series of defects in locomotives which has come to personal observation was a veritable plague of leaking dome caps occurring on a large eastern railway. Like the hot truck boxes before mentioned it could not be traced to faulty design, or

workmanship. The dome caps were of cast steel of the usual form, seating against a copper wire gasket which in turn bore against the pressed steel top of the dome body. This construction is well illustrated in Fig. 304 on page 247 of the *Locomotive Encyclopedia* of 1925.

The cutting always occurred in the cast steel lid, or removable cap and was not confined to any one part of the circumference of the lid bearing face; nor did it invariably occur midway between two adjacent fastening studs. Either one of these conditions would have indicated a definite basis for the trouble. If steam grooving of the bearing face of the lid had occurred always at the same point it would have been a clue to destructive eddy currents in the dome and these could have been controlled by baffling. If the leakage had occurred uniformly, midway between adjacent studs, buckling of the lid would have been indicated and heavier dome lids applied.

Of course everybody had a theory. Electrolytic action was vaguely hinted at, destructive acids in the boiler water were blamed, and, of course, the quality of the material in the lid came in for some criticism. Working on the theory that the porosity of the cast lid was to be blamed for the trouble, the writer used a burnishing tool such as is commonly employed for the final rolling of the surface of piston rods and refinished the gasket seats of several of the caps, believing that rolling would compress the surface metal in the lid and render it less susceptible to grooving or cutting. This remedy seemed effective for a time but months later, after the writer had accepted other employment, a letter from a former associate, mentioned the fact that "dome cap trouble has broken out again." Presumably, there was a destructive chemical reaction present which could only be offset temporarily by mechanical expedients.

"Always something to make life interesting" growled a certain master mechanic, as he read to his staff extracts from a letter from the superintendent of motive power, in which the number of engine failures due to broken piston rings and piston valve rings came in for severe criticism.

The criticism was not unexpected, since for some little time prior to receipt of the letter, everyone had been renewing piston rings and valve rings at an unprecedented rate and had been trying to discover a cause for the apparently poor lubrication of pistons and valves. The staff meeting mentioned was given over to a discussion of this one subject and finally a theory as to the cause of the trouble was evolved. It was remembered that this particular plague was a seasonal one; it always came in the spring and early summer. With this in mind, one enginehouse foreman gave as his solution of the matter the fact that feedwater supplies were very much muddied and disturbed by spring floods and since cases of foaming in boilers were going hand-in-hand with cases of ring breakage, evidently a good deal of water was being primed into engine cylinders and valve chambers; lubrication was being nullified and packing rings were being broken.

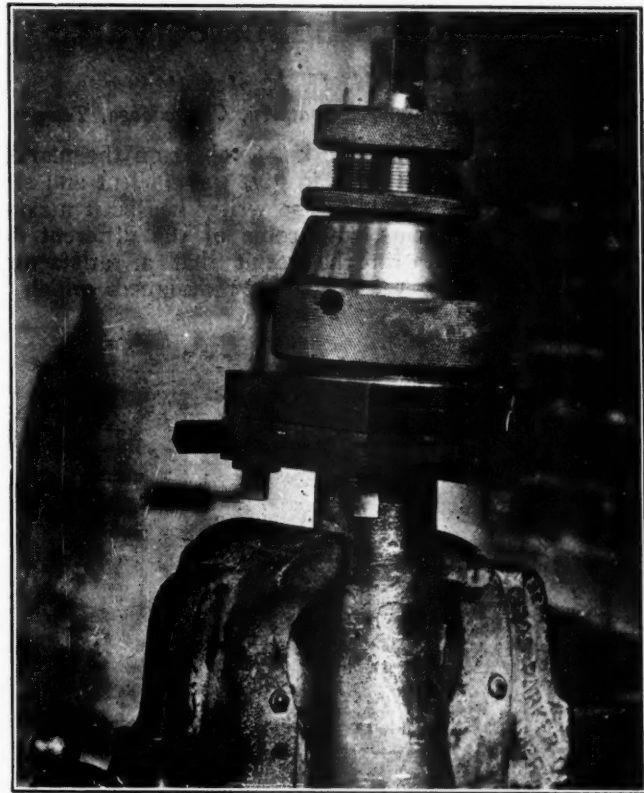
Since this theory called for a readjustment of water supplies, the trouble died a seasonal death before the water engineers of the system managed to apply all the corrective measures at their command, but it was significant that the next spring saw no recurrence of the trouble because of forestalling remedies applied in the preceding autumn and winter.

With all their annoyance and with all the extra work they cause, it is still an open question whether or not the average railroad executive would forego an occasional outburst of a specific trouble even if he could do so. They have their value as indices of underlying condi-

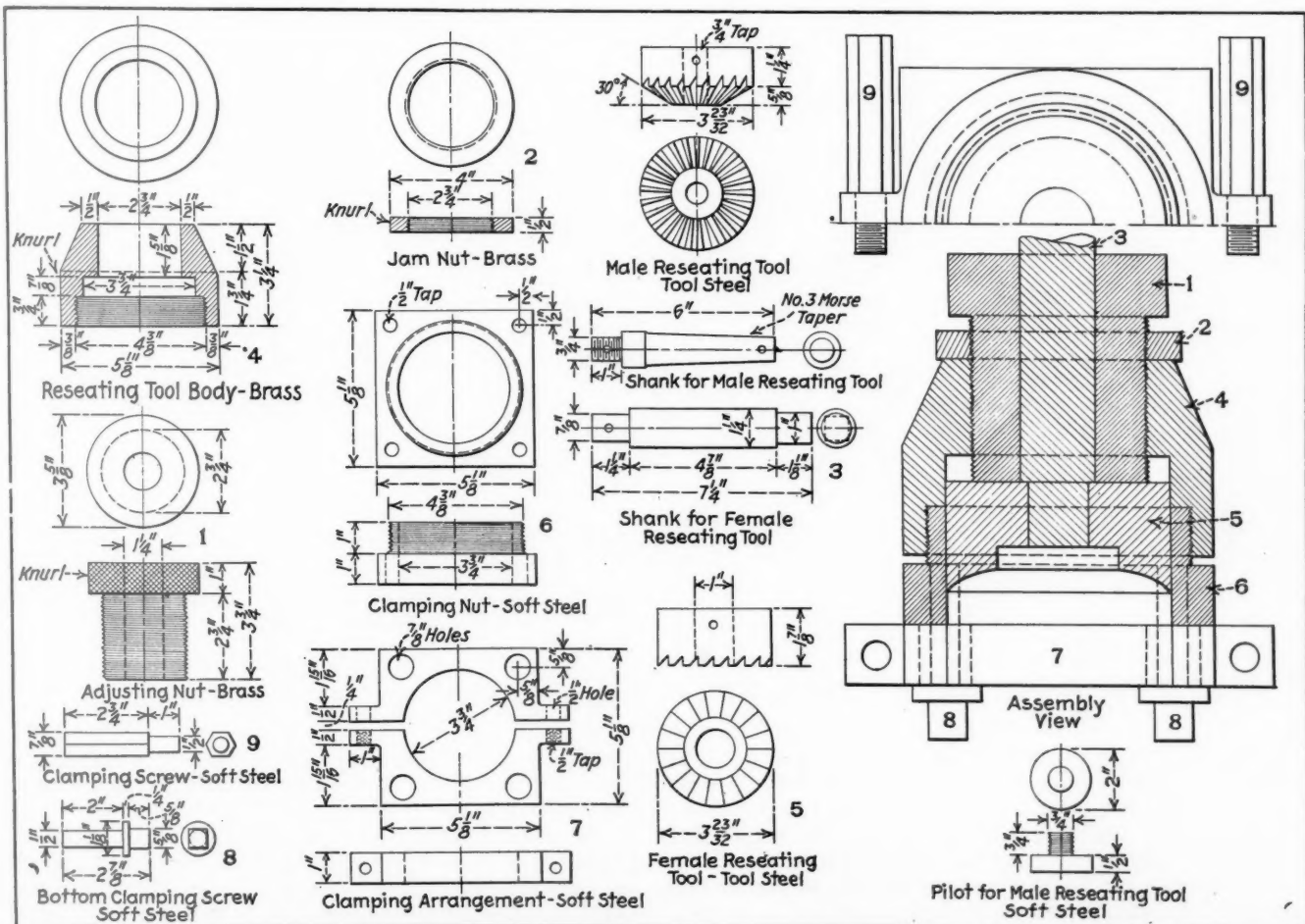
tions which should be investigated and corrected and they undoubtedly contribute indirectly to the morale of repair forces. We, of the railroads, are hardly as yet, educated to the slogan of the medical profession—that it is more blessed to prevent than to cure. In time, we may be. Until that day arrives that we can anticipate all mechanical troubles, we can all confess to an honest sense of pride not only in those cases where we have fought epidemics of mechanical defects and conquered them, but even in those cases where we were not so successful but where we struggled on to the limit of our resources and knowledge.

Special reseating tool for inspirators

THE special reseating tool shown in the accompanying illustration was designed to face the joints on steam pipes and branch pipes of non-lifting inspirators and also for facing the connections on inspirators to insure a good steam-tight joint without the use of gaskets. The tool consists of an adjusting nut which screws into the reseating tool body. The proper reseating tool and shank, which extends up through the adjusting nut, is placed in the reseating tool body which is screwed into the bottom clamping nut. The whole is then held firmly onto the pipe end by a two-part clamp. The extended shank of the reseating tool is turned with a closed wrench by hand.



The reseating tool in place for facing the joint of a steam pipe



Details of a special reseating tool for inspirators

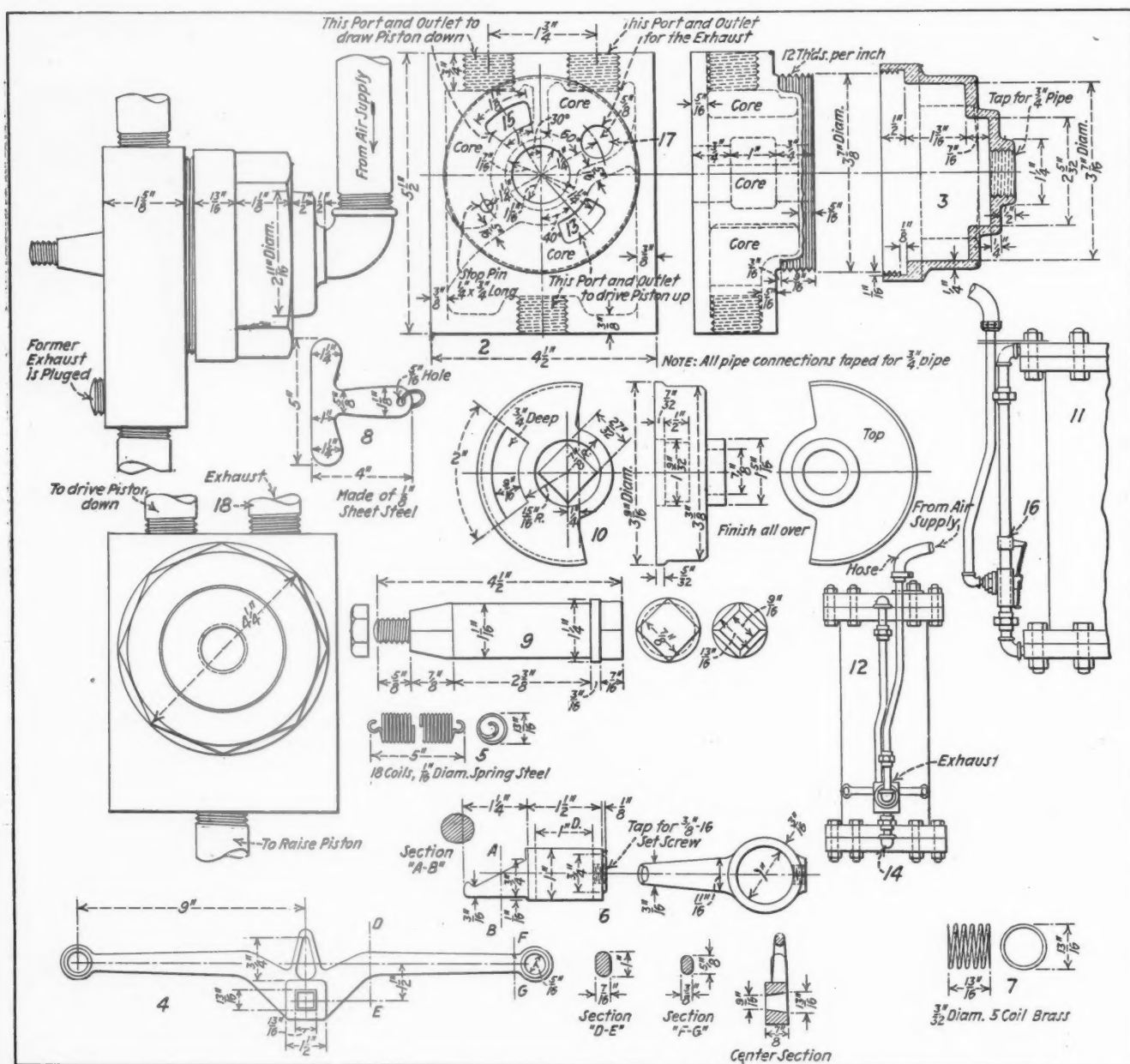
Air hoist balance valve

By H. H. Henson

Machine shop foreman, Southern, Chattanooga, Tenn.

THERE are many air hoist valves on the market, none of which seem to give the efficient and safe service that they should. The writer has been making extensive experiments with some of the different designs of valves, with the result that a satisfactory balanced air hoist valve has been designed, which is

hoist valve that is safe, but also from the fact that the piston will stop immediately and stay in that position every time the operator releases his hand from lever 4, located at the hand-hole 8. The lever 4 is held in a horizontal position with the coil spring 5. Every time the operator releases his hold, the lever resumes its horizontal position. Air is admitted on both sides of the piston through the balanced valve, thereby equalizing the piston. The main reservoir pressure is exerted against the balanced rotary valve 10, inside of the case 3. When the load is to be raised, the lever 4 is pulled down on the



Details of the air hoist balance valve

shown in the accompanying illustration. Six of these balanced valves are in daily service and have proved safe and efficient from every angle. The largest hoist equipped with this design of balanced valve was tested by placing a 6,000-lb. weight on the end of the piston which was suspended half of the length of the piston stroke. The weight and piston remained in this position for two hours without any movement whatever.

Satisfaction is not only derived from operating a

right side, admitting air through port 13 which enters the lower section of the cylinder through pipe 14, until the desired height is obtained. The lever 4 is then released which balances the rotary valve 10 on seat 2, thus admitting air on both sides of the piston cylinder 12 through the two ports shown at 13 and 15. The rotary valve is adjusted with a coil spring and lug 16. Every time the piston moves up or down, exhaust air is released through exhaust port 17 and then out through pipe 18.

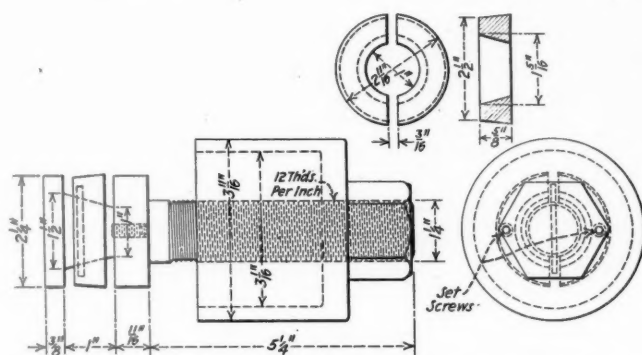
Air pump bushing puller

By F. A. Pearce

Air room foreman, Grand Trunk Western, Battle Creek, Mich.

A GREAT many different methods have been devised for removing the small 6-port piston valve cylinder cover bushing in the top head of the 8½-in. cross compound air compressor pump. Some time ago the *Railway Mechanical Engineer* published the description of a bushing puller the principal feature of which was six pawls which snapped outward into the six vertical ports of the bushing and served as the means of pulling the bushing out. Experience proved this an excellent design of puller but it had one drawback—the pawls would break off.

In an endeavor to overcome this difficulty the design



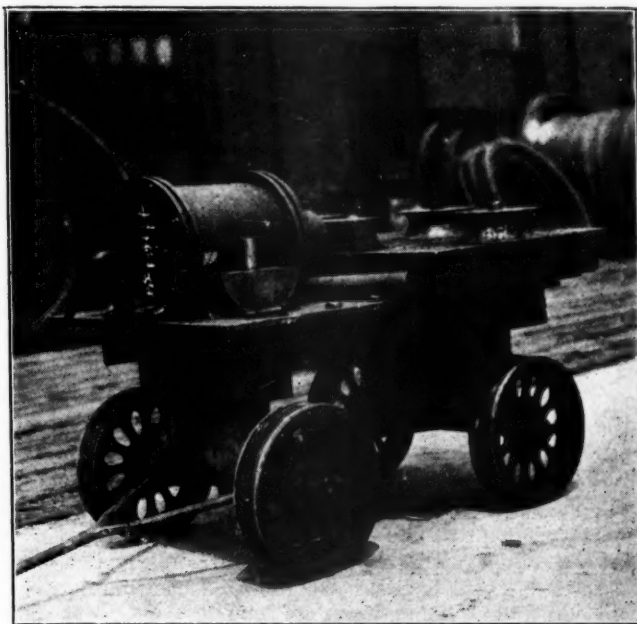
Puller for the bushing in the small cylinder cover of the 8½-in. cross-compound air compressor

shown in the accompanying drawing was developed. It consists of a body which is threaded at one end and at the other has two guides, slightly smaller in diameter than the inside of the bushing, with a taper shank between them. Two hardened steel tapered jaws are fitted on the tapered shank with a ⅛-in. steel pin through the shank between them. In removing a bushing the body with the two jaws is placed in the bushing and the two set screws shown in the upper guide are tightened down against the jaws, which, sliding on the taper shank, are forced outward against the wall of the bushing. The cup-shaped cover is then placed over the threaded end of the puller body and seated against the face of the cylinder cover. By screwing the nut down against the top of the cup-shaped puller cover the tapered jaws are forced outward and, becoming embedded in the inside wall of the bushing, serve to pull the bushing up into the cup-shaped cover.

A portable arch tube bending machine

THE pipe bending machine shown in the photograph was devised by William Mulcahy, erecting shop foreman at the Garrett, Ind., shops of the Baltimore & Ohio. The machine is portable, mounted on a sturdy four-wheel truck of ordinary shop size. The base is made up of an old shaper bed, in the slots of which are mounted three rollers or dies which are adjustable and have a range or radii suitable for bending various sizes of pipe. The power is furnished by a standard 12-in. by 12-in. air brake cylinder, operated by an engineman's brake valve. The operation and design are simple throughout.

While adaptable for bending pipes of any size, the machine is particularly suited to bending arch tubes. Formerly, almost three hours were required to bend a set of tubes, by the heating, bending and cooling process. The task occupied the time of a mechanic and a helper. With the new machine a set of tubes can be bent in less



A set of arch tubes can be bent in 25 min. on this machine

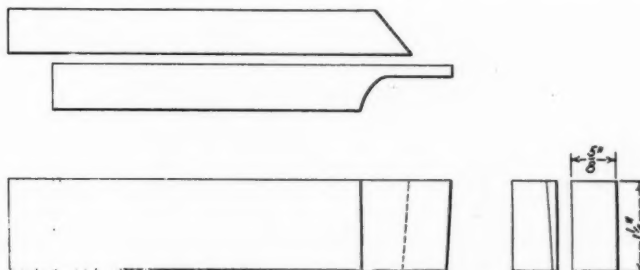
than 25 min., without crimping the pipe. It is claimed that the job is much better than that done by the old process, and requires less than one-sixth of the time.

Cutting off and beveling cylinder bushings

By J. Robert Phelps

Apprentice instructor, A. T. & S. F., San Bernardino, Cal.

THE illustration shows two tools to be used together for cutting off and beveling cylinder bushings in one operation on a boring mill. As a cylinder needs boring to receive a bushing, the bore is run to the front edge of the back ports. This permits the bushing to press against the solid shoulder of the cylinder instead of



Tools for beveling and cutting off cylinder bushings in one operation on a boring mill

against the back head. It also makes it necessary to counterbore the bushing in the front end only; that is, the top as the bushing sets on the boring mill. The bushing is cut off by feeding the tool down the inside of the bushing. The tool will cut off the bushing and give the correct bevel.

The Reader's Page

The division mechanical foreman

MINDEN, La.

TO THE EDITOR:

He holds down a job remote from the shops,
With a force that is obviously small.
A place where all trains make regular stops
And he has no roundhouse at all.
All the shop he has is a bench in a shack,
With only a torch for a light,
Packs driving boxes on the cinder-pit track,
Nor has an assistant at night.

He's acting caller and roundhouse clerk,
Disburser of fuel and supplies,
Must see that the carmen are doing their work,
And that each job goes through on the fly.
All engines handled are reported each day,
He makes boiler-washing report,
Accounts for each roundhouse delay,
Repressing all caustic retort.

He gets work done with available tools,
Diplomatic toward connecting lines;
Must be familiar with interchange rules,
Yet mindful of whose axe he grinds.
He patiently listens to grievous tales
Of engines that blow and pound,
Or, perhaps to a fireman who loudly wails:
"How come I've been run around?"

He never complains, or asks for relief,
Just handles what comes his way.
Things that might cause another man grief
To him, are just part of a day.
So we give the old boy a pat on the back,
When we happen to be passing by,
Depending on him to take up the slack,
Without ever questioning why. —J. B. Searles

Proper credit for three-cylinder valve motion patents

GALVESTON, Texas.

TO THE EDITOR:

In connection with H. S. Vincent's letter on page 701 of your November issue, it should be mentioned that a system of levers for deriving the motion of the inside valve of a three-cylinder locomotive from the combined movements of the two outside valves was devised in 1909 by H. Holcroft of the Swindon Works of the Great Western Railway, England. Mr. Gresley has stated that Mr. Holcroft deserves the credit of having first devised an arrangement by which only two valve gears are necessary for three-cylinder locomotives. The valve gear designed at Swindon was not, however, applied to any locomotive, as the four-cylinder, simple engines on the Great Western for fast passenger service.

The first three-cylinder locomotives constructed with a combination valve gear was built by Henschel & Son, for the Prussian State Railways. This was a heavy tank engine of the 2-8-2 type, and made its first trial run on the Berlin Metropolitan Railway in February, 1913. In May, 1914, the first of the Prussian three-cylinder 4-6-0 passenger locomotives appeared and in August, 1915, the first of the numerous 2-10-0 locomotives of the G-12 class was built. On the ten-wheelers, the levers were in a horizontal plane, while the experimental tank engine and the decapods had a more complicated arrangement of vertical levers, the underlying principle in all cases being the same.

All of the above mentioned types were actually running prior to the date of Mr. Gresley's patent and it should be further noted that the first three-cylinder locomotive built by Mr. Gresley did not leave the Doncaster works of the Great Northern until May, 1918.

WILLIAM T. HOECKER.

Applying good management to the car shop

SCRANTON, Pa.

TO THE EDITOR:

The character of the work performed in the average railroad car repair shop is of such a nature that many supervisors are apt to overlook the need of applying the principles of good management to the work. Many of the practices considered fundamental to the successful operation of a manufacturing or production shop can not be applied in the same way to a large repair shop. The ultimate cost of production in car repair shops depends a great deal on personnel, the layout of the repair tracks and buildings and its machine tool equipment. I recently had occasion to visit a shop where the management had found it impossible to institute a piece-work schedule that was being used in another shop on the same system, which was equipped with identical machine tools, until the entire equipment had been relocated. This situation could have been avoided if the proper officers of the mechanical department had given the same study to the shop in which the machine tools had to be relocated as they evidently did to the shop where the piece-work schedule was functioning successfully.

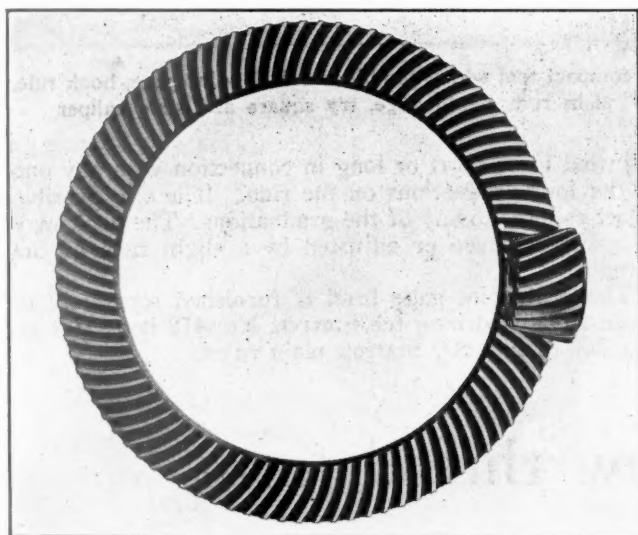
Visits to various car shops throughout the country have revealed many instances where the application of the principles of good management have been seemingly ignored by the officers responsible for the layout of the plant. Quite a number of articles have been published in past issues of the *Railway Mechanical Engineer* on various phases of car shop management and location. It seems, however, that this subject could be given further study, especially by mechanical department officers of railroads who have to contend with antiquated repair facilities. Perhaps there are other readers of the *Railway Mechanical Engineer* who have had experiences similar to mine who will have something to say on this subject.

A. N. NELSON.



Spiral Drive vertical turret lathes

THE Bullard Machine Company, Bridgeport, Conn., is manufacturing a new series of vertical turret lathes which is known as the Spiral Drive type. This series supersedes the previous New Era type and embodies several recent changes. Some of the more important features include changes in ma-



The spiral bevel gear and pinion used to drive the table of the new Bullard vertical turret lathe

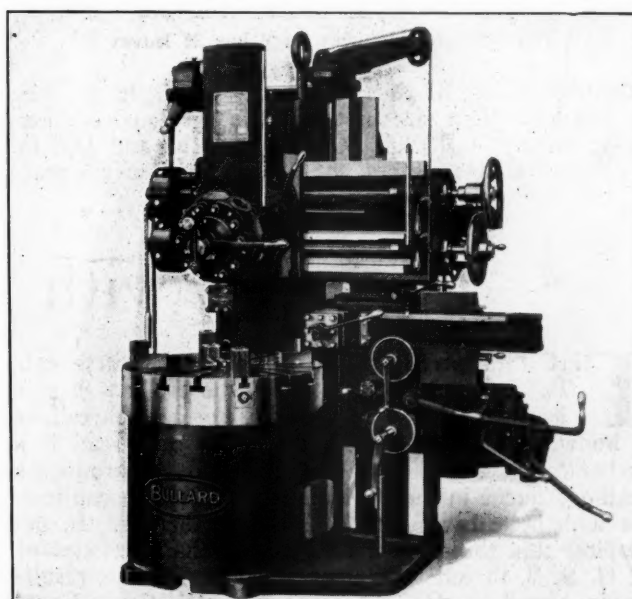
terials of construction, the most notable being the all-steel main slide and turret. The later design of turret locking mechanism is also an improvement.

The feature from which this new series takes its name is the adoption of a spiral bevel table drive gear and pinion. The advantages of this type of drive include a smoother table action and more constant transmission of power. The spiral gear tooth also increases the tooth strength for a given pitch. The design provides a pinion amply supported with a wide bearing on either side, and a table gear of the largest permissible diameter for each size of machine, firmly built in as an integral part of the table, spindle and chuck unit. The Bullard method of lubrication provides a constant flow of oil at this point.

The new series includes not only the 24-in., 36-in., 42-in. and 54-in. sizes previously built, but offers a

larger size, to be known as the 64-in. Spiral Drive type. The design of this new size follows the general lines that have been carried out in the other four sizes. Its capacity, however, provides 66 in. of clear swing in diameter and a clearance in height of approximately 34 in. for the larger diameter swing under the crossrail, and 48 in. under the turret face. The new model is furnished with a plain table provided with parallel and radial tee-slots. The standard equipment includes four independent face plate jaws with drop forged steel bodies, special alloy steel moving parts, and a differential actuating screw.

There are twelve changes in table speed ranging from $2\frac{1}{2}$ r. p. m. to 43 r. p. m., which are selectively ob-



The Spiral Drive vertical turret lathe which is provided with an all-steel main slide and turret

tained through two systems of sliding gears and controls that interlock with the clutch and brake.

Both the main head and the side head are provided with eight positive and independent changes of feeds. Means for adjustment and control are within easy reach of the operator when standing in the natural working position.

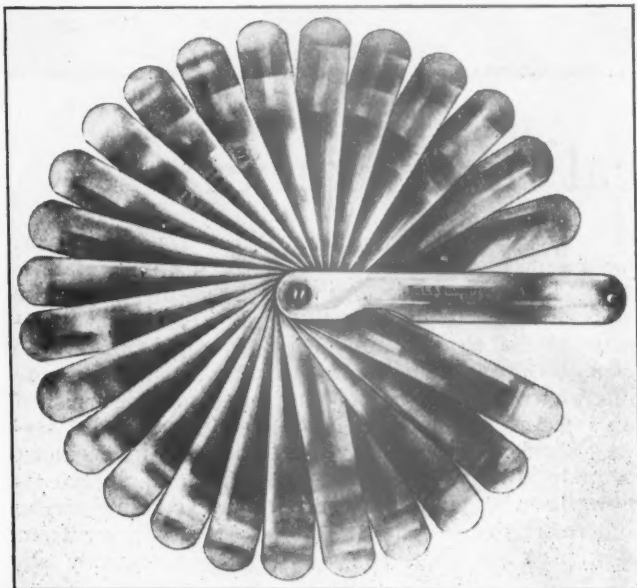
The new size of machine is particularly adaptable to

large work requiring boring, turning and facing operations, and permits the effective use of both heads simultaneously. This machine has a net weight of approxi-

mately 28,000 lbs. and the space occupied is 10 ft. 6 in. square by 11 ft. high for fully extended machine capacity.

Starrett thickness gage and combination tool

A COMPACT but complete thickness or feeler gage, No. 66, has recently been placed on the market by the L. S. Starrett Company, Athol, Mass. This gage gives a complete range of thicknesses from .0015 in. to .025 in. By using leaves in combination, an almost



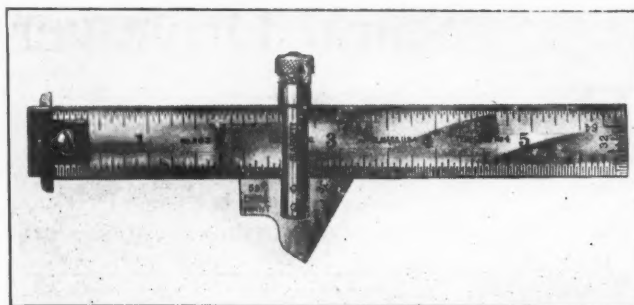
The Starrett thickness gage has 26 leaves

unlimited variety of thicknesses may be obtained. The gage contains four sizes not found in previous combinations; namely, .0015 in., .002 in., .0025 in. and .003 in. With these thinner leaves, the No. 66 gage covers prac-

tically every requirement. The leaves are $3 \frac{1}{6}$ in. long and $\frac{1}{2}$ in. wide.

Another compact combination tool is the new No. 22-C drill point gage. It consists of a 6-in. steel rule with a sliding head which makes contact with the rule at an angle of 59 deg. A knurled thumb screw locks the head at any desired point.

This tool is a convenience when grinding small drills. The combination with the double end hook rule gives it a wide variety of uses. The hook on the rule can be



A compact tool which combines a drill point gage, hook rule, plain rule, depth gage, try square and slide caliper

adjusted to be short or long in connection with any one of the four graduations on the rule. It is also possible to set calipers to any of the graduations. The hook may be easily removed or adjusted by a slight turn of the eccentric stud.

The drill point gage head is furnished separately to those already owning the Starrett No. 418 hook rule or No. 300 or No. 600 Starrett plain rules.

Lock nut with new thread form

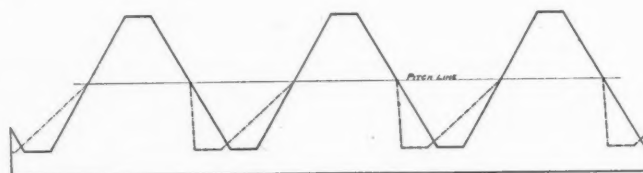
THE Graham Bolt & Nut Company, Pittsburgh, Pa., has recently announced the production of a lock nut with a self locking form of thread, to be known as the Selflock. This form of thread is a mechanical development of screw threads to produce a locking element in nuts, which can be used in conjunction with bolts having U. S. Standard threads. In developing this thread as many of the characteristics of the U. S. S. thread were maintained as possible, resulting in the following common characteristics: Equal areas, true U. S. S. lead, location of pitch line and U. S. S. flats.

One of the illustrations shows clearly a comparison of the Selflock thread with the U. S. S. The pitch line location is the same and it will be noticed that the thread form inside the pitch line is identically the same as U. S. S. while outside the pitch line the thread angles are slightly changed.

In the design of this lock nut there is no distortion of the thread, the lead being true U. S. S. and the helix angle constant. Due to the equal thread areas no mate-

rial is removed when Selflock nuts are applied on U. S. S. threaded bolts. The lead being true U. S. S. the nut may be applied from either face, the holding power developed being the same in either case.

When Selflock nuts are applied, that part of the thread



The Selflock thread compared with U. S. Standard thread

on the bolt lying outside the pitch line is slightly tipped so as to create a definite frictional lock on every thread engaged by the nut. Should it be necessary to remove the nut it will require more wrench load to break the contact and start the nut off the bolt than was required

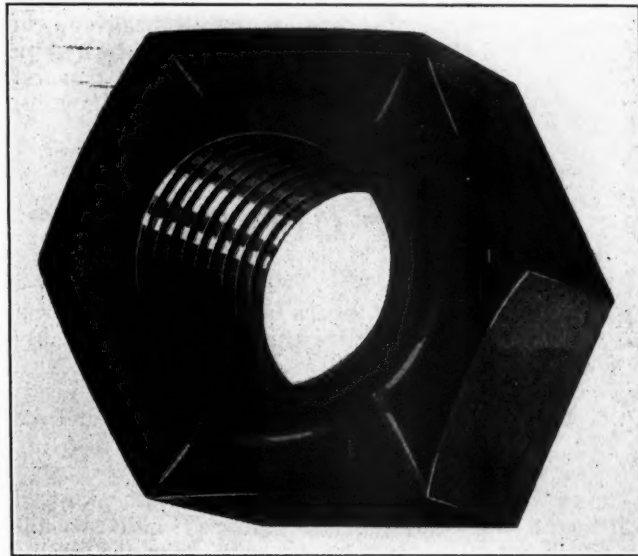
to put it on. The Selflock nut is applied in the usual manner—started with the fingers and wrenched to position.

U. S. S. nuts may be applied to bolts having had Selflock nuts on them. Should the U. S. S. nut be reasonable in size, a certain frictional lock will be developed as it will be necessary to bring the thread on the bolt back to suit the U. S. S. conditions in the nut. Selflock nuts may be applied many times to the same bolt thread. Should this be done so many times that sufficient lock is not developed, the nut can be reversed when the locking feature will again function.

Because of the fact that the locking feature of the Selflock nut is cut into the solid metal of the nut, it is impossible for the workman to change its locking value in any way—the material from which the nut is made cannot be normalized.

The manufacturer has been experimenting with this type of lock nuts for some time and actual service tests on locomotives, freight cars, frog and crossing bolts, track bolts, forging machines, cranes, rolling mill equipment and similar installations where severe vibratory conditions prevail are said to have demonstrated satisfactorily the ability of this type of thread to resist the loosening effect of vibration. The star crown shown in one illus-

tration has been adopted as a means of identifying these nuts.



The star crown identifies Selflock nuts

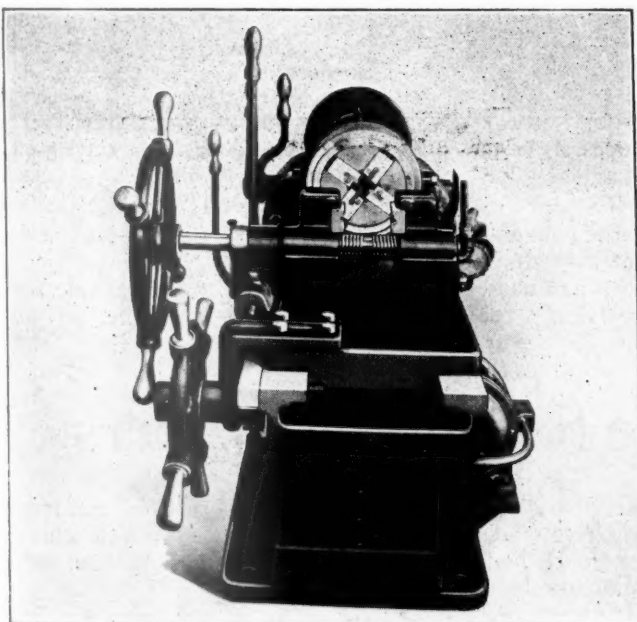
Williams Rapiduction bolt-threading machine

A BOLT-THREADING and cutting machine of the geared-head type, particularly designed for production, has just been placed on the market by the Williams Tool Corporation, Erie, Pa. The machine is compact and follows the modern trend of machine-

care of by the length of the dies. To cut a different size thread, the operator can quickly change dies simply by loosening the locking screw and taking the die from the holder.

Dies are furnished $\frac{3}{8}$ in. to $1\frac{1}{2}$ in., inclusive, for the $1\frac{1}{2}$ -in. machines and $\frac{1}{2}$ in. to 2 in., inclusive, for the 2-in. machines. Nut taps are also furnished within the same range.

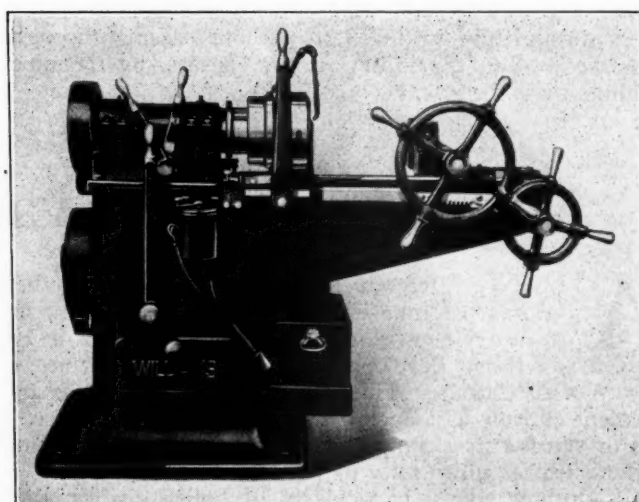
The operator has complete control of the machine from one position and can get seven different speeds by operating only two levers. To change gears, it is only necessary to ease out on the clutch which permits the placing of one or both gear shift levers. A speed plate back



A large die holder is used to support the small renewable dies

tool design by having the motor at the base instead of above.

The machine uses large die-holders to support small renewable dies of high-speed steel. The large die-holders do not have to be removed from the head in order to change dies. Neither is there any special head adjustment needed, except for the actual fitting of the thread that is to be cut. The size of the thread desired is taken



Front view of the Williams Rapiduction bolt threader

of the levers gives the correct position for each size of bolt.

Another feature of the machine is the simplicity of the automatic die head. The several parts—the die head, die

head support, cam, cam ring, die-holders and shell—are all enclosed, forming one compact unit.

The shell, which is controlled by compression springs, travels backward and forward on the die head and, in turn, opens and closes the dies. The head is adjusted by pulling the lever forward and is released by a trip rod in the carriage. The trip rod can be set to give any de-

sired length of thread within the capacity of the machine. The dies are adjusted by releasing the cam ring from the shell. A spanner wrench, engaged in the cam ring, is moved backward or forward in order to give a larger or smaller adjustment for the size of thread to be cut. The cam ring is then locked to the shell, holding the die-holders in a fixed position.

Motor driven pipe threader and cutter

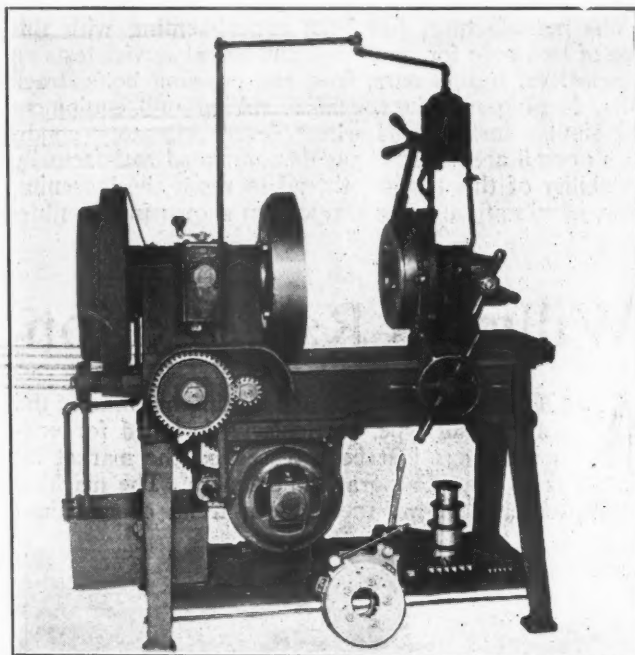
THE illustration shows one of the two motor driven pipe threading and cutting machines recently placed on the market by D. Saunders' Sons, Inc., Yonkers, N. Y. The No. 4-B is equipped with die heads for threading pipe from ½ in. to 4 in., inclusive, and the No. 5-B is equipped for threading pipe 1 in. to 6 in., inclusive.

The two machines are motor driven, and are equipped with motor and controller and equipped with two adjustable expanding die heads with interchangeable chasers. A set of standard blank gages for use in setting chasers, and an automatic oil pump and wrenches are also supplied with each machine.

The machines are arranged for operation by alternating current, the electrical equipment consisting of a 3-hp. constant speed induction motor with a drum type controller for forward and reverse speeds. The motor is geared to the driving shaft of the machine. Changes of speed are secured by the shifting of gears of and off the ends of the machine shafts. Sufficient gears are furnished to take care of all sizes within the capacity of the machine.

The cutting-off head is arranged with a tool slide and self-centering vee-jaws to steady the pipe while it is being cut off. The carriage, with the cutting-off head and die-head, is moved by a rack and pinion worked by a hand-wheel. It is arranged with the die-head on the front, sliding in ways which allows the die-head to be brought close to the gripping chuck. After the pipe has been threaded and is to be moved to adjust it for cutting off, or for any other reason, the die-head is pushed to one side, allowing the pipe ample room to pass through the cutting-head without passing through the die-head to the injury of the chasers, by the pipe sliding over them.

The gripping chuck for holding the pipe is of the standard universal type. At the rear end of the spindle,



Saunders' motor driven pipe threading and cutting-off machine

on the side of the large driving gear, is a two-jaw, self-centering chuck to center the pipe.

An automatic oil pump is attached to the machine for supplying a constant flow of oil to the machine.

Automatic timing valve for Hanna riveters

A TIMING valve which automatically controls the duration of time during which the full tonnage of the riveter remains on the rivet after it is driven is a recent development of the Hanna Engineering Works, Chicago. This device eliminates the human element entirely as a factor affecting the quality of rivets driven hot in a compression type riveter and to that extent insures uniformity of product.

In driving rivets, particularly of boiler quality, the full tonnage of the riveter is maintained on the rivet after its head is formed, while the rivet cools sufficiently to recover its full cold strength, insuring that the hole is filled and the plates tightly gripped. The time for sufficient cooling under die pressure will vary with the diameter and length of the rivet. Each riveting job is likely, therefore, to require a different timing. It has

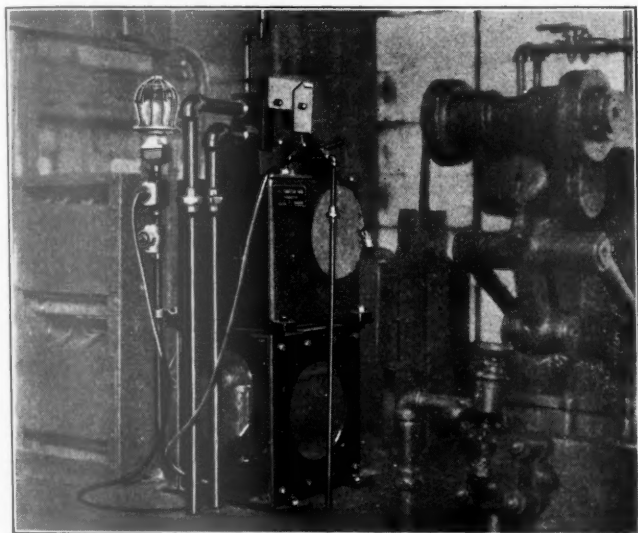
been found that, when the dwell period is uniform, tight rivets were obtained with 10 seconds dwell where 15 seconds had formerly been the standard without this timing mechanism.

In operation, the operator depresses the valve handle, whereupon the die advances on the rivet. Instantly after each rivet is 50 per cent driven, the valve goes beyond the control of the operator. The riveter finishes and dwells on the rivet for a predetermined period, and at the expiration of this time the valve automatically reverses, returning the riveter mechanism to its starting position. The valve may, however, be reversed manually as the rivet die is advancing, but before it strikes the rivet. This constitutes an important safety feature.

The valve may be set or adjusted for any duration of dwell period, from 1 second to 60 seconds. This is done

by direct reading and requires no trials. The valve may be sealed, once it is set, and cannot be tampered with without breaking the padlock seal. It may be placed at any point for convenient operation as it is a self-contained unit.

The timing element is a constant speed, fractional

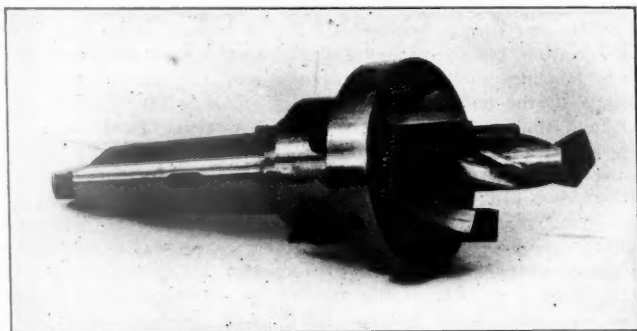


The full tonnage of the riveter is maintained on the rivet while it cools by means of the Hanna automatic timing valve

horsepower motor with a gear reduction and can be arranged for either alternating or direct current of any voltage.

Trepanning tool for flue sheets

THE special trepanning tool illustrated has been designed by W. L. Brubaker & Bros. Co., 50 Church street, New York, for cutting holes 3 in. in diameter and larger in flue sheets. It combines a standard drill, with a Morse taper shank, with special tools for trepanning and chamfering. The tool is made in positive sizes with no radial adjustments. Both the trepanning and cham-



Brubaker trepanning tool for flue sheet holes 3 in. in diameter or larger

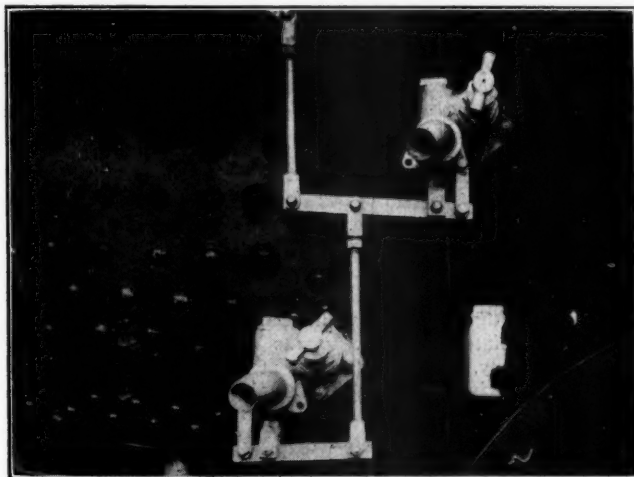
fering cutters may be adjusted longitudinally, however, to maintain the proper lengths after grinding. The range of adjustment permits the maximum use of the cutters, all of which are made from high-speed steel to assure long life.

This tool is designed to give shorter production time and, hence, lower cost of production owing to the performing of several operations in one set-up, and accu-

rate cutting of holes owing to the rigid support of the cutters.

Locomotive sludge remover

THE Bird-Archer Company, Chicago, has placed on the market a sludge remover which is designed to remove sludge from all parts of the mud ring as well as from the bottom of the boiler shell. The device consists of slotted pipes which run along the belly of the boiler and the waterlegs of the firebox. These pipes are copper and are slotted or drilled at intervals along the bottom for their entire length. They are attached directly to two large blow-off cocks, both located



Exterior view of sludge remover showing the lever rigging for operating both blow-off cocks at the same time

on the same side of the firebox and connected to the same operating lever in the cab, as shown in the illustration. When the blow-off cocks are open, the upper one draws sludge through the slotted copper pipe from the bottom of the boiler shell and the lower one draws sludge through the slotted pipes from the water legs.

Since the slotted pipes are made of copper there is less tendency for scale to deposit on them and no pitting.

Nitro-cellulose lacquer and pyroxylin thinner

IN the past it has been considered necessary to furnish lacquer finishing materials ready mixed by the manufacturer. This has meant that a separate stock of lacquer of each color used had to be maintained by the purchaser. A clear nitro-cellulose lacquer has been developed by Clarence Brooks & Co., 249 Chestnut street, Newark, N. J., with which the user may mix in his own shop any desired commercial japan color. A pyroxylin thinner has been developed for use in reducing the mixed lacquer to any desired consistency. When used either with colors or clear, the lacquer works in any of the commercial spray guns.

In using this lacquer, after the requisite number of color coats have been sprayed on, the addition of one coat of clear lacquer will give a semi-gloss finish. A second coat of clear lacquer provides a brilliant finish without recourse to rubbing and polishing. By this system the color coats are protected by an additional film of clear lacquer which takes the brunt of the weathering and the ordinary wear and tear of cleaning which a passenger car receives while in service.

News of the Month

The Atchison, Topeka & Santa Fe has purchased a car repair plant near Kedzie avenue and Thirty-fifth street, Chicago, with 50 acres of ground, which it has leased for the past 15 years.

The Chicago Tube & Iron Company and Warren, Corning & Co. have been consolidated under the name of the former company. E. E. Peter remains chairman of the Chicago Tube & Iron Company. The other officers of the company will be Warren S. Corning, president; Fred Gardener, vice-president and general manager; E. M. Peter, treasurer and E. S. Nathans, secretary.

R. H. Cross, branch manager of the Seattle Branch of the Timken Roller Bearing Service & Sales Company, has been promoted to assistant to the district manager of sales of the industrial division, with headquarters at Seattle, Wash., and will be succeeded by Yale D. Hills, representative, with headquarters at Canton, Ohio. E. N. Beisheim, formerly representative of the Bock Bearing Company, with headquarters at Toledo, Ohio, has been appointed assistant to the general manager of the Timken Company, with headquarters at Canton. S. C. Partridge has been placed in charge of the Buffalo office of the industrial division, to succeed Lee Warrender, who has resigned to engage in other business.

The Railway Steel-Spring Company recently closed its office in Louisville, Ky. The business of this district will hereafter be handled by George B. Powell, sales agent, Syndicate Trust building, St. Louis, Mo. W. E. Corrigan, district sales manager for the American Locomotive Company, Rialto building, San Francisco, Cal., now represents also the Railway Steel-Spring Company, succeeding Herbert G. Cook, who has represented the Spring Company on the Pacific coast for a number of years. The business of the combined companies will be handled from Mr. Corrigan's present address. A. W. Sullivan, sales agent of the Railway Steel-Spring Company at Pittsburgh, has moved his offices from Twentieth and Liberty streets to the Farmers Bank building, Pittsburgh, Pa.

William Larimer Jones, president of the Jones & Laughlin Steel Corporation, Pittsburgh, Pa., and one of the leading steel makers of the country, died at his home in Pittsburgh on November 25. He was graduated from Princeton University in 1887 with the degree of bachelor of science, and from that time devoted his life to the steel manufacturing industry. He began work in the mills at Pittsburgh as assistant to his father, Thomas M. Jones, general manager of the company, and upon the latter's death in 1889, succeeded him as general manager. In 1906 he was elected vice-president of the company, and in 1922, upon the formation of the present Jones & Laughlin Steel Corporation, was made its president, succeeding his cousin, B. F. Jones, Jr., who became chairman of the board of directors.

L. E. Porter, who has been elected vice-president of S. F. Bowser & Co., Inc., Fort Wayne, Ind., was born at Petoskey, Mich., on October 2, 1880. He entered the employ of S. F. Bowser & Co., Inc., on January 11, 1909, and after working in various capacities in the Dallas, Texas, office, the St. Louis, Mo., office and on special sales work at Chicago, he was appointed district manager, with headquarters at St. Louis. On December 1, 1919, he was transferred as district sales manager to Detroit, Mich., which position he held until September 27, 1920, when he was appointed director of publicity at Fort Wayne, Ind. On August 1, 1922, he was appointed assistant general manager, and on March 16, 1925, was appointed treasurer, which position he held until his recent promotion to vice-president in charge of industrial and engineering sales.

Wage increases

THE CHICAGO & ALTON has granted an increase of 1½ cents an hour to first-class mechanics.

WAGE INCREASES of three cents an hour have been granted to the federated shop crafts of the Chicago, Milwaukee & St. Paul and the Chicago & North Western. The agreement with the employees of the former road is retroactive to December 15, while that with the latter became effective January 1.

Retaining valves need attention

Information recently received by the Committee on Brakes and Brake Equipment of the American Railway Association, Mechanical Division, indicates that retaining valves are not given proper consideration when cars are being painted and Circular D. V. 500 has been issued on this subject. Instances are reported, wherein, due to carelessness in painting, the ports in the retaining valves are blocked with paint, particularly the small vent port in the retaining valve cap or body, causing improper operation of the retaining valve and, in some cases, overheated and broken wheels. The committee believes that each railroad should call the attention of air brake repairmen and also those in charge of painting cars to this practice, in order that inspection may be made following the painting of cars to determine that the exhaust and vent ports are not obstructed, or that suitable provisions are made to protect the retaining valves while cars are being painted.

Meetings and Conventions

Interchange car inspectors confer

On January 19 and 20, fifteen chief inspectors, representing car interchange bureaus at widely separated points in the United States, held a meeting at Chicago for the purpose of considering mutual problems and deciding how the bureaus can best work together. The meeting was presided over by T. J. O'Donnell, chief interchange inspector, Buffalo, N. Y., and about one-half of all the chief interchange inspectors in the country were present personally or sent representatives. It was decided not to organize an association, but to confine activities to the holding of two informal meetings each year, the first as soon as possible after the issuance of the new interchange rules effective the first of the year, and the second, during the early part of March for the purpose of recommending changes to be considered by the Arbitration committee in preparing its report for the June convention of the American Railway Association, Mechanical division. It was agreed that attendance at the meetings should be confined to chief interchange inspectors and their assistants, except that the chairman may invite others to present information bearing on the work. In view of the many rules and regulations under which car interchange bureaus work, it is not surprising that numerous divergent opinions develop between the chief interchange inspectors which lead eventually to conflicting decisions. It is anticipated that these differences in opinion can be largely ironed out at the proposed meetings, and that all inspectors will be governed by rules unanimously agreed upon, while all questions not unanimously agreed to will be referred to higher authorities for decision. The chief interchange inspectors do not propose to withdraw their support from the Railway Car Department Officers' Association, formerly known as the Chief Interchange Car Inspectors' and Car Foremen's Association of America, but feel that these meetings for the informal and exclusive consideration of car interchange bureau problems will be helpful.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs.

- AIR-BRAKE ASSOCIATION.**—T. L. Burton, acting secretary, 165 Broadway, N. Y. Next meeting May 24, 25, 26 and 27, Mayflower Hotel, Washington, D. C.
- AMERICAN RAILROAD MASTER TINNERS', COPPERSMITHS' AND PIPEFITTERS' ASSOCIATION.**—C. Borchardt, 202 North Hamlin Ave., Chicago.
- AMERICAN RAILWAY ASSOCIATION DIVISION V.—MECHANICAL.**—V. R. Hawthorne, 431 South Dearborn St., Chicago. Next meeting June 7, 8 and 9, Hotel Windsor, Montreal.
- DIVISION V—EQUIPMENT PAINTING SECTION.**—V. R. Hawthorne, Chicago.
- DIVISION VI.—PURCHASES AND STORES.**—W. J. Farrell, 30 Vesey St., New York.
- AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.**—G. G. Macina, 11402 Calumet Ave., Chicago. Annual convention, Chicago, August 31, September 1 and 2.
- AMERICAN SOCIETY OF MECHANICAL ENGINEERS.**—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Railroad Division, Marion B. Richardson, associate editor, *Railway Mechanical Engineer*, 30 Church St., New York.
- AMERICAN SOCIETY FOR STEEL TREATMENT.**—W. H. Eiseman, 4600 Prospect Ave., Cleveland, Ohio.
- AMERICAN SOCIETY FOR TESTING MATERIALS.**—C. L. Warwick, 1315 Spruce St., Philadelphia, Pa.
- AMERICAN WELDING SOCIETY.**—Miss M. M. Kelly, 29 West Thirty-ninth St., New York.
- ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS.**—Joseph A. Andrucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill.
- BIRMINGHAM CAR FOREMEN AND CAR INSPECTORS' ASSOCIATION.**—P. H. Gillean, 715 South Eightieth Place, Birmingham, Ala. Meeting, second Monday in each month at Birmingham, Y. M. C. A. Building.
- CANADIAN RAILWAY CLUB.**—C. R. Crook, 129 Charon St., Montreal, Que. Regular meetings second Tuesday in each month, except June, July and August, at Windsor Hotel, Montreal, Que.
- CAR FOREMEN'S ASSOCIATION OF CHICAGO.**—Aaron Kline, 626 N. Pine Ave., Chicago, Ill. Next meeting Feb. 14, Great Northern Hotel, Chicago, Ill. Continued discussion new A. R. A. Rules.
- CAR FOREMEN'S ASSOCIATION OF ST. LOUIS.**—F. D. Wiegmar, 720 North 23rd St., E. St. Louis, Ill.
- CAR FOREMEN'S CLUB OF LOS ANGELES.**—J. W. Krause, 514 East Eighth St., Los Angeles, Cal. Meeting second Friday of each month in the Pacific Electric Club Building, Los Angeles, Cal.
- CENTRAL RAILWAY CLUB.**—H. D. Vought, 26 Cortlandt St., New York, N. Y. Next meeting Feb. 10, Hotel Statler, Buffalo, N. Y. Old-timers' night.
- CHIEF INTERCHANGE CAR INSPECTORS' AND CAR FOREMEN'S ASSOCIATION.**—A. S. Sternberg, Belt railway, Clearing Station, Chicago. Annual convention, Chicago, September, 1927.
- CINCINNATI RAILWAY CLUB.**—D. R. Boyd, 811 Union Central Building. Next meeting Feb. 8, Hotel Gibson. Paper on Commercial development from railroad viewpoint, by Gayle W. Arnold, industrial agent, B. & O. Dinner party musical entertainment and moving picture by Air Reduction Sales Co.
- CLEVELAND RAILWAY CLUB.**—F. L. Frericks, 14416 Adler Ave., Cleveland, Ohio. Meetings first Monday each month except July, August and September, at Hotel Hollenden, Cleveland, Ohio. Next meeting Feb. 7. Discussion changes in 1927 A. R. A. Rules.
- INTERNATIONAL RAILROAD MASTER BLACKSMITHS' ASSOCIATION.**—W. J. Mayer, Michigan Central, 2347 Clark Ave., Detroit, Mich. Next meeting Hotel Lafayette, Buffalo, N. Y., August 16-18, 1927.
- INTERNATIONAL RAILWAY FUEL ASSOCIATION.**—L. G. Plant Railway Exchange, 80 E. Jackson boulevard, Chicago. Annual convention May 10 to 13, 1927, Chicago.
- INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.**—William Hall, 1011 W. Wabash Ave., Winona, Minn. Annual convention Chicago, September 6-9, 1927.
- LOUISIANA CAR DEPARTMENT ASSOCIATION.**—L. Brownlee, New Orleans, La. Meeting third Thursday in each month.
- MASTER BOILERMAKERS' ASSOCIATION.**—Harry D. Vought, 26 Cortlandt St., New York. Annual meeting Chicago, May, 1927.
- NEW ENGLAND RAILROAD CLUB.**—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Next meeting Feb. 8, Copley-Plaza Hotel, Boston. Paper on feedwater heaters on locomotives will be read by V. L. Jones, asst. mech. engineer, N. Y., N. H. & H.
- NEW YORK RAILROAD CLUB.**—H. D. Vought, 26 Cortlandt St., New York. Meetings third Friday in each month, except June, July and August, at 29 West Thirty-ninth St., New York.
- PACIFIC RAILWAY CLUB.**—W. S. Wollner, 64 Pine St., San Francisco, Cal. Regular meetings, second Thursday of each month in San Francisco and Oakland, Cal., alternately.
- RAILWAY CLUB OF GREENVILLE.**—Paul A. Minnis, Bessemer & Lake Erie, Greenville, Pa. Meeting 1st Friday of each month, except June, July and August.
- RAILWAY CLUB OF PITTSBURGH.**—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa. Regular meeting fourth Thursday in month, except June, July and August. Fort Pitt Hotel, Pittsburgh, Pa.
- ST. LOUIS RAILWAY CLUB.**—B. W. Frauenthal, Union Station, St. Louis, Mo. Regular meetings, second Friday in each month, except June, July and August.
- SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.**—A. T. Miller, P. O. Box 1205, Atlanta, Ga. Regular meetings third Thursday in January, March, May, July, September and November.
- SOUTHEASTERN CARMEN'S INTERCHANGE ASSOCIATION.**—C. Kimball, Inman shops, Southern, Atlanta, Ga.
- TEXAS CAR FOREMEN'S ASSOCIATION.**—A. I. Parish, 106 West Front St., Fort Worth, Tex. Regular meetings, first Tuesday in each month, Terminal Hotel Bldg., Fort Worth, Tex.
- TRAVELING ENGINEERS' ASSOCIATION.**—W. O. Thompson, 1177 East Ninety-eighth St., Cleveland, Ohio. Annual meeting Hotel Sherman, Chicago, September, 1927.
- WESTERN RAILWAY CLUB.**—Bruce V. Crandall, 189 West Madison St., Chicago. Regular meetings, third Monday in each month, except June, July and August.

Supply Trade Notes

Frederick Hackmann, president of the Hackmann Railway Supply Company, Chicago, died on January 17.

W. J. Savage, railroad service engineer of the Anchor Packing Company, Chicago, has been promoted to assistant district manager.

Philip Robinson, manager of sales of the Gary Screw & Bolt Company, Chicago, has been elected vice-president and general manager of sales.

J. O. Dearth has been appointed district sales manager of the Central Alloy Steel Corporation, Massillon, Ohio, with headquarters at Cincinnati, Ohio.

Edward H. Mattingley, formerly representative of the Chicago-Cleveland Car Roofing Company, Chicago, has been appointed representative of the Bradford Corporation, Chicago.

D. D. Grassick, formerly general inspector of car construction of the Atchison, Topeka & Santa Fe, has been appointed insulating engineer of the Insulite Company, Minneapolis, Minn.

O'Neill Ryan, Jr., advertising manager of the Celotex Company, Chicago, has been promoted to assistant general sales manager in charge of sales promotion, and will be succeeded by Edwin Cox.

C. E. McGregor, formerly representative of the Republic Flow Meters Company, Chicago, has been appointed representative of the Brown Instrument Company, Philadelphia, Pa., with headquarters at Chicago.

The Union Manufacturing Company, New Britain, Conn., has purchased and taken over the entire assets of the Franklin-Moore Company, of Winsted, Conn., who manufacture a complete line of chain hoists, blocks, trolleys, etc.

John T. Carroll, general superintendent motive power and equipment of the Baltimore & Ohio, has resigned and has entered the railway supply business with office at 203 Citizens National Bank building, Baltimore, Md.

Fred S. Doran has been appointed manager of the Cleveland plant of Joseph T. Ryerson & Son, Inc. This new warehouse plant of the Ryerson Company was purchased from the Bourne-Fuller Company of Cleveland on January 3.

Lester B. Paterson has resigned his position with the American Locomotive Company, and is now connected with the Combustion Engineering Corporation as assistant production manager, with office at 200 Madison avenue, New York City.

The Magor Car Corporation, 30 Church street, New York, has opened an office at 133 West Washington street, Chicago, to handle railway sales in Illinois, Michigan and Minnesota, the office having been placed in charge of W. P. Meigs.

Robert K. Johnson has been appointed president of the Pyro-tung Manufacturing Company, Chicago, to succeed W. R. Otis, resigned. Charles W. Mann has been appointed vice-president. Charles E. Pynchon, general manager, has resigned.

The Worthington Pump & Machinery Corporation has bought the Harris Air Pump Company of Indianapolis, Ind., manufacturers of air lift systems and air lift pumps. The purchase was outright and includes patents, drawings, patterns and good-will.

Henry N. Winner, general manager of the Garlock Packing Company, Palmyra, N. Y., died at Philadelphia on November 12, after a brief illness. Mr. Winner was born in Brooklyn on September 19, 1879, and had spent his entire life in the mechanical packing business.

On January 1, the Sharon, Pa., tank car plant and the Beaumont, Texas, structural steel fabricating plant of the Pennsylvania Car Company were taken over by the Petroleum Iron Works Company, Sharon, Pa. These two plants will be known and operated as the Pennsylvania tank car department and the structural steel department of the Petroleum Iron Works Company.

William H. Hodgins, secretary of the Okonite Company, died after a brief illness on January 7 at his home in Glen Ridge, N. J. Mr. Hodgins had been associated with the Okonite Company for over 40 years, and served for many years as a director, in addition to his office as secretary.

The North American Car Corporation has purchased the plant of the North Judson Car & Equipment Company, North Judson, Ind., and will use the plant for the repair and distribution of their tank cars, refrigerators and the poultry cars of the Palace Poultry Car Company, one of its subsidiaries.

Walter C. Kershaw, service engineer of the Elwell-Parker Electric Company, at New York, died suddenly on December 24 at his home in Asbury Park, N. J. Mr. Kershaw, previous to service with the Elwell-Parker Electric Company, had been for a number of years with the Pennsylvania Railroad.

The Air Reduction Company, Inc., has acquired, through a long term lease from the Commercial Acetylene Supply Company, Inc., the plants and business of that company on the Pacific Coast. The two acetylene manufacturing plants taken over are located, respectively, at Berkeley and Los Angeles, Calif.

F. J. Foley has been elected vice-president in charge of the sales department of the American Locomotive Company, with headquarters at New York. Mr. Foley was born on May 14, 1879, at Chillicothe, Ohio. He began service as a messenger boy on the Baltimore & Ohio, at Newark, Ohio, in 1893, afterwards working as a telegraph operator and train dispatcher on several railroads in the middle west until 1897, when he entered the manufacturing department of the Pullman Company at Pullman, Ill. Mr. Foley had been with the Railway Steel-Spring Company since its incorporation in 1902, in charge of its several plants, becoming general superintendent of the company in 1912, and vice-president of sales in 1919. He leaves the latter position to go with the American Locomotive Company.



F. J. Foley

The Midland Pipe & Supply Company, Chicago, has been organized to handle pipe, valves and fittings, and has opened an office and warehouse at 4638 Roosevelt road. J. E. Walsh, formerly representative of Warren Corning & Co., has been made vice-president, and E. P. Pieper, formerly controller of inventory of the Wheeling Steel Corporation, is secretary and treasurer.

E. McCormick, vice-president in charge of financial affairs of the Railway Steel-Spring Company at New York, has been appointed vice-president in charge of sales, succeeding F. J. Foley, who has been appointed vice-president in charge of sales of the American Locomotive Company. L. S. Peabody, local sales agent of the Railway Steel-Spring Company at New York, has been appointed district sales manager, with headquarters at New York City.

At a recent meeting of the board of directors of the American Car & Foundry Company, Dallas B. Pratt and F. F. Fitzpatrick were elected directors of the company. Mr. Pratt, a member of the firm of Maitland, Coppel & Company, succeeded Gerald L. Hoyt, deceased, who had been a director of the company since 1901. Mr. Fitzpatrick is president of the American Locomotive Company. Messrs. Pratt and Fitzpatrick were also elected directors of the American Car & Foundry Securities Corporation. At the same meeting of the American Car & Foundry Company, C. D. Terrell was elected vice-president, with headquarters at Chicago. At the time H. W. Wolff, vice-president, was transferred to New York and placed in charge of sales, he was suc-

ceeded in Chicago by Mr. Terrell, whose designation was that of assistant vice-president. L. W. Martin, formerly sales agent, has been appointed assistant to vice-president, with headquarters at St. Louis, as heretofore.

Edwin H. Peirce of Worcester, Mass., has been elected vice-president and general manager of the Niles-Tool Works Company, Hamilton, Ohio, and will be the assistant to James K. Cullen, president. Mr. Peirce is a graduate of Harvard, Class of 1904. For the past 19 years he has been active in the American Steel & Wire Company of the United States Steel Corporation. For about six years he was superintendent of the New Haven Works of the American Steel & Wire Company and for the past two years had been superintendent of the South Works.

Anson Wood Burchard, vice-chairman of the board of directors and chairman of the executive committee of the General Electric Company and chairman of the board of directors of the International General Electric Company, died on January 22 in New York City. Mr. Burchard was born in Hoosick Falls, N. Y., on April 21, 1865. He graduated from Stevens Institute of Technology in 1885 with the degree of mechanical engineer. In 1902 he joined the organization of the General Electric Company and until 1904 was controller, with headquarters at Schenectady. In 1904 he was appointed assistant to the president; in 1912 he was elected a vice-president, and in 1917 was elected a member of the board of directors. In May, 1922, Mr. Burchard was elected vice-chairman of the board, and in June of the same year he was elected president and chairman of the board of directors of the International General Electric Company. About a year ago he was relieved of the duties of president, but continued as chairman of the board. He was director of several utility and electrical companies.

Frank W. Hamilton, associated with several New York business men, has purchased the interests of Cadwallader R. Mulligan in the Ulster Iron Works, at Dover, N. J. Mr. Hamilton, formerly vice-president and general manager, is now president of the company, succeeding John Mulligan, deceased. Henry T. Bradley, formerly manager of sales, is vice-president. John D. B. Vreeland will continue as secretary and treasurer. E. W. Kavanagh, associated with the sale of Ulster products for several years, has been appointed sales manager. The Ulster Iron Works was established at Saugerties, N. Y., in 1827. In 1863 William Mulligan assumed the management, and with him was associated his brother, Cadwallader R. Mulligan. The latter in 1883 took over the management of the Dover Iron Works at Dover, N. J., and one year later he moved the business of the Ulster Iron Works, which had outgrown the facilities at Saugerties, to Dover. Later the firm name was changed to Ulster Iron Works, Incorporated, and John Mulligan became the president, holding the office at the time of his death, which occurred last May. The new management will continue the business under the same name and without change in its policy.

Warren Corning, who has become president of the Chicago Tube & Iron Company following its consolidation with Warren Corning & Company, was born in Peoria, Ill., in 1889, and received his education at Mt. Pleasant Military Academy, Kenyon College and the University of Chicago. In 1912 he entered the employ of the Hewitt Manufacturing Company, Chicago, where he was employed in the plant, and in the following year became sales representative. In 1914 he organized Corning, Dunne & Company, Chicago, which in 1916 was taken over by Warren Corning & Company. In 1917 he discontinued the operation of this company to enter the army as a private in the Thirteenth Engineers. After being promoted to sergeant and to first lieutenant in the department of light, railways and roads, he was commissioned captain of Company D of the Third Engineers. Later he was appointed aide-de-camp to Major General M. M. Black, chief of engineering. In 1918 he returned to civil life to resume the operations of his company, which occupation he has followed until his recent election. Fred Gardner, who became vice-president and general manager of the Chicago Tube & Iron Company following the consolidation, entered business in the sales department of Joseph T. Ryerson & Son in 1908. In 1913 he became associated with the Oxweld Railroad Service Company, and in 1923 resigned to become president of the Chicago Tube & Iron Company, which position he has held until his recent appointment.

Personal Mention

General

W. O. THOMPSON, formerly general superintendent of rolling stock of the New York Central, at Buffalo, N. Y., has been appointed equipment assistant, with the same headquarters.

W. H. FLYNN, general superintendent of motive power of the New York Central line East and West of Buffalo, has been appointed general superintendent of motive power and rolling stock, with the same headquarters.

R. H. FLINN, master mechanic on the Western region of the Pennsylvania, at Columbus, Ohio, has been promoted to superintendent of motive power of the Northern division, Central region, with headquarters at Buffalo, N. Y.

AUGUST MUELLER, in addition to his duties as supervisor of automatic train control of the Chicago, Rock Island & Pacific, has been appointed air brake instructor, with headquarters shifted from Des Moines, Iowa, to Chicago, succeeding W. J. Hartman, deceased.

JOHN DANIELS, road foreman of engines on the Oregon-Washington Railroad & Navigation Company, with headquarters at LeGrande, Ore., has been appointed general fuel supervisor, with headquarters at Portland, Ore., succeeding A. W. Perley, deceased.

F. KERBY, supervisor of locomotive operation of the Baltimore & Ohio, with headquarters at Cumberland, Md., has been appointed assistant to the chief of motive power and equipment with headquarters at Baltimore, Md.



F. Kerby

operation of the Baltimore & Ohio, with headquarters at Cumberland, Md., has been appointed assistant to the chief of motive power and equipment with headquarters at Baltimore, Md. He was born July 23, 1864, at St. Clairsville, Pa., and has been in the continuous service of the Baltimore & Ohio since 1903, starting as locomotive engineman on the Cumberland division. For the next ten years he was engineman or air brake inspector on the Connellsville, Philadelphia and Chicago divisions, being promoted to supervisor of locomotive operation on the staff of the general manager of the Eastern lines in 1913. In 1916, he was promoted to a similar position on the staff of the vice-president in charge of operation, from which he has now been advanced to assistant to the chief of motive power and equipment.

T. W. COE, master mechanic on the Nickel Plate district of the New York, Chicago & St. Louis, at Conneaut, Ohio, has been promoted to superintendent of motive power, with jurisdiction over the Nickel Plate and Lake Erie & Western districts, with headquarters at Cleveland, Ohio, succeeding W. G. Black, who has resigned to accept a position with another company.

FREDERICK W. HANKINS, general superintendent of motive power of the Central region of the Pennsylvania at Pittsburgh, Pa., has been promoted to chief of motive power, with headquarters at Philadelphia, Pa., succeeding J. T. Wallis. Mr. Hankins was born on January 1, 1876, at London, England, and was educated in the public schools of Foxburg, Pa. He entered the employ of the Pittsburgh & Western as a machinist apprentice on April, 1891, and from April, 1894, to April 21, 1905, served consecutively as a machinist on the Baltimore & Ohio and the Allegheny Valley. On the latter date he became engine-house foreman on the Cumberland Valley; in May, 1912, general foreman, and in May, 1916, master mechanic. On January 1,

1919, he was appointed master mechanic on special work in the office of general superintendent of motive power of the Pennsylvania; in March, 1902, was promoted to assistant chief of motive power, Pennsylvania System, and in 1923 became general superintendent of motive power of the Central Region.

JAMES T. WALLIS, chief of motive power of the Pennsylvania System, at Philadelphia, Pa., has been promoted to assistant vice-president in charge of operation, with the same headquarters.



J. T. Wallis

Mr. Wallis was born on June 11, 1868, at New Orleans, La. He was educated at the University of Louisiana, Georgetown College, and the Stevens Institute, graduating from the latter school in 1891. He entered the employ of the Pennsylvania Railroad on September 16, 1891. His promotions were as follows: October, 1894, machinist at West Philadelphia, May, 1896, assistant road foreman of engines, Philadelphia, Baltimore & Washington Railroad; April, 1899, assistant master me-

chanic, New York division; May, 1900, assistant master mechanic machine shop at Altoona, Pa.; July, 1900, assistant engineer motive power in office of general superintendent motive power; October, 1901, assistant engineer motive power, Pennsylvania railroad division; January, 1903, master mechanic, Baltimore division, Northern Central Railway; April, 1906, master mechanic, Philadelphia Terminal division at West Philadelphia; April, 1907, superintendent motive power, Erie division and Northern Central railway; May, 1911, superintendent West Jersey & Seashore railroad; January, 1912, general superintendent motive power, Pennsylvania railroad, Lines East of Pittsburgh. On March 1, 1920, he was appointed chief of motive power of the Pennsylvania System.

Master Mechanics and Road Foremen

J. R. AGNEW has been appointed road foreman of engines of the Washington division of the Southern, with headquarters at Alexandria, Va.

J. K. MORGAN, general foreman of the Chicago, Rock Island & Pacific at Little Rock, Ark., has been promoted to master mechanic, with headquarters at Dalhart, Tex.

J. B. CRAHAN, general foreman of the locomotive department of the Missouri Pacific, at St. Louis, Mo., has been appointed master mechanic of the Wichita division, with headquarters at Wichita, Kan., succeeding J. P. Downs, resigned.

LUCIUS SEAM has been appointed master mechanic in charge of the locomotive department, car shops and coal dock of the Copper Range, with headquarters at Houghton, Mich., succeeding Gilbert Bisson, resigned.

A. W. TURNER, road foreman of engines of the Michigan Central at Jackson, Mich., has been appointed division master mechanic, with headquarters at Niles, Mich., succeeding W. H. Corbett, who has been relieved at his own request.

Car Department

L. E. DELFRAISSE has been promoted to car foreman of the Missouri Pacific, with headquarters at Mart, Tex.

JOHN GILL, car foreman of the Delaware, Lackawanna & Western at Kingsland, N. J., has been promoted to passenger car foreman, with headquarters at Hoboken, N. J.

Shop and Enginehouse

C. H. VENSO has been promoted to boilermaker foreman of the Missouri Pacific, with headquarters at Kingsville, Tex.

A. M. FIREBAUGH has been promoted to day roundhouse foreman of the Missouri Pacific, with headquarters at Kingsville, Tex.

L. L. TAYLOR has been promoted to assistant night roundhouse foreman of the Missouri Pacific, with headquarters at Van Buren, Ark.

V. N. POTTS has been promoted to general foreman of the Missouri Pacific, with headquarters at Kingsville, Tex., succeeding A. M. Firebaugh.

K. A. LENTZ, erecting shop foreman of the Southern, at Spencer, N. C., has been promoted to shop superintendent, with the same headquarters.

H. M. WOOLSTON has been promoted to erecting shop foreman of the Missouri Pacific, with headquarters at Kingsville, Tex., succeeding V. N. Potts.

R. W. HUMBERT has been promoted to night roundhouse foreman of the Missouri Pacific, with headquarters at Mart, Tex., succeeding J. J. Mooney.

P. J. KITCHEN, general foreman of the Chicago, Rock Island & Pacific at Waurika, Okla., has been transferred to El Dorado, Ark., succeeding F. L. Coles.

J. J. MOONEY has been promoted to general foreman of the Missouri Pacific, with headquarters at Houston, Tex. Mr. Mooney was formerly night roundhouse foreman at Mart, Tex.

G. DABNER, general foreman of the Missouri Pacific at North Little Rock, Ark., has been promoted to general foreman, with headquarters at St. Louis, Mo.

A. B. ERICKSON, division foreman of the Missouri Pacific at Dupo, Ill., has been promoted to general foreman of the locomotive shops at North Little Rock, Ark., succeeding G. Dabner.

T. DEVANEY, master mechanic on the Clover Leaf district of the New York, Chicago & St. Louis, at Frankfort, Ind., has been appointed superintendent of shops, with the same headquarters.

Purchases and Stores

C. L. McILVAINE has been appointed assistant to the stores manager of the Pennsylvania with headquarters at Philadelphia, succeeding R. C. Harris.

A. J. MELLO has been appointed purchasing agent in charge of purchases and stores of the Pacific Fruit Express, with headquarters at San Francisco, Cal.

The jurisdiction of R. L. TINDAL, purchasing agent of the New York, Chicago & St. Louis with headquarters at Cleveland Ohio, has been extended to cover the entire system following the discontinuance of the purchasing department of the Clover Leaf district at Toledo, Ohio.

WALTER E. EVANS, assistant to the general purchasing agent of the Canadian National, at Montreal, Que., has been promoted to purchasing agent of the Grand Trunk Western system, with headquarters at Detroit, Mich., succeeding George W. Caye, retired under the pension rules of the company.

C. E. WALSH, assistant purchasing agent of the Pennsylvania at Philadelphia, Pa., has been promoted to purchasing agent, with the same headquarters, succeeding Montgomery Smith. Mr. Walsh was born on September 20, 1882, at Uhrichsville, Ohio, and entered railway service on May 6, 1899, as a storeroom clerk on the Pittsburgh, Cincinnati, Chicago & St. Louis (now a part of the Pennsylvania). After a number of advancements he became assistant purchasing agent in 1914. In 1920 he became assistant purchasing agent, Central region, with headquarters at Pittsburgh, and in 1924 was appointed assistant purchasing agent of the Pennsylvania Railroad system, which position he was holding at the time of his recent promotion.

CHAUNCEY B. HALL, who has been appointed stores manager of the Pennsylvania, with headquarters at Philadelphia, Pa., was born on March 7, 1875, at Baltimore, Md., and was educated in the public schools of that city and at Baltimore City College.

He entered railway service on August 11, 1891, with the Northern Central (now a part of the Pennsylvania) as a messenger. He occupied various clerical positions until July 1, 1908, at which time he entered the purchasing department as a special inspector. On March 1, 1916, he was appointed sales agent, and in October of the following year, chief clerk in the purchasing department. On March 1, 1920, Mr. Hall became assistant to the purchasing agent, and in October of the same year, assistant to the general purchasing agent. He was appointed general storekeeper on February 1, 1926, which position he was holding at the time of his appointment as stores manager.

MONTGOMERY SMITH, who has been promoted to assistant to the general purchasing agent of the Pennsylvania with headquarters at Philadelphia, Pa., was born on October 28, 1862, at Philadelphia, Pa., and was educated in the public schools of that city. He entered railway service on July 23, 1879, as a clerk in the office of the auditor of passenger receipts of the Pennsylvania. From August 22, 1879, until December 1, 1893, he was a clerk in the purchasing department, and on the latter date became lumber clerk, which position he held until February 1, 1896, when he became chief accountant. On June 1, 1900, he became chief clerk and on November 12, 1902, assistant to the purchasing agent. From June 15, 1905, until March 1, 1920, he was assistant purchasing agent at Philadelphia. This service was all with the Pennsylvania Railroad. On March 1, 1920, he became purchasing agent of the Eastern region of the Pennsylvania system, and on January 16, 1924, was promoted to purchasing agent of the Pennsylvania system, which position he was holding at the time of his promotion to assistant to the general purchasing agent.

E. G. WALKER, chief clerk in the purchasing department of the Atchison, Topeka & Santa Fe, has been promoted to assistant general purchasing agent, with headquarters at Chicago. Mr.



E. G. Walker

Walker was born on October 5, 1870, on a farm near Howe, Ind. He graduated from the Goshen (Ind.) High School in 1887 and for several years taught school and studied law. In 1894 he returned to his farm and in 1898 he entered railway service in the stores department of the Lake Shore & Michigan Southern (now a part of the Michigan Central) at Elkhart, Ind. He remained at this point until 1903, when he entered the stores department of the Santa Fe in a clerical capacity at Albuquerque, N. M.

Mr. Walker served for a short time in 1904 on the Chicago, Rock Island & Pacific at Moline, Ill., and in 1905 he returned to the Santa Fe at Topeka and was then transferred to Chicago, being promoted to assistant chief clerk of the purchasing department in 1910. In November, 1913, he was promoted to chief clerk.

Obituary

ROBERT B. HUBBELL, for about 15 years purchasing agent at New York for the International Railways of Central America, died on January 13 at Kingston, Jamaica, at the age of about 84 years. Previous to his service with the International Railways Mr. Hubbell had served as purchasing agent of the United Fruit Line.

P. J. SCHUYLER, road foreman of engines of the Harrisburg Division of the Reading, died on December 27 at Harrisburg, Pa., following an operation for kidney trouble. Mr. Schuyler entered railway service in 1877 as a foreman on the Central of New Jersey, being promoted in 1880 to engineer. He became assistant road foreman of engines of the Reading division of the Reading in 1902 and in 1906 was promoted to road foreman of engines of the Harrisburg Division.